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Physics Abstracts

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	Photocells	Electroacoustic apparatus
Electronic relays and counters	Thermionic tubes	Radiocommunication
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PHYSICS ABSTRACTS

Volume 59 AUGUST 1956 Number 704

MATHEMATICS 51

517.3

5594. ON THE METHOD OF STATIONARY PHASE. G.Braun.
Acta phys. Austriaca, Vol. 10, No. 1-2, 8-33 (1956). In German.

Methods are given for the approximate evaluation of integrals of functions of the form $g(x)\exp\{i\omega f(x)\}$, or the two-dimensional analogue of this. Asymptotic series in ω are obtained. The results receive physical application in the wave mechanical theory of electron optics, and these are discussed in the author's 1954 dissertation at the Technische Hochschule, Vienna. L.S.Goddard

517.512.2 : 535.81

5595. OPTICAL FOURIER SYNTHESIZER. L.Mertz.
J. Opt. Soc. Amer., Vol. 46, No. 7, 548-51 (July, 1956).

Fourier harmonics in the form of Young's interference fringes, may be added together by successive exposures on a photographic plate. In the synthesizer to be described, an optical system using a Wollaston prism generates the Young's fringes with adjustable spacing, position, and intensity. This provides the necessary variations of frequency, phase, and amplitude of the harmonics simply by setting dials. The apparatus is potentially capable of adding a few hundred harmonics, as can be shown by preliminary experimental results. Spherical aberration in the optical system merely remains to be corrected. A.

518.2 : 621.37.01

5596. LAGUERRE FUNCTIONS: TABLES AND PROPERTIES. J.W.Head and W.P.Wilson.
Proc. Instn Elect. Engrs, Monogr, No. 183R, publ. June, 1956, 13 pp. To be republished in Part C.

The first 21 Laguerre functions have been tabulated to four decimal places (or two significant figures when this is more accurate) for values of the argument 0(0.1)1(0.2)3(0.5)6(1)14(2)40(5)100. The practical applications of these functions are briefly considered. The zeros of these Laguerre functions are also tabulated to 5 places, the last of which is not reliable except in the case of the smallest zero for orders above 6. Differentiation and integration of Laguerre functions, orthonormal properties and addition formulae are briefly discussed. Finite or infinite series of Laguerre functions whose sums are well-known functions such as products of polynomials and circular or exponential functions, step and delta functions, Bessel and Kelvin functions, and gamma and error functions are stated. The general methods used for deriving some of these results are indicated. A.

518.5 : 681.142 : 621.374.4

5597. FUNCTION GENERATORS BASED ON LINEAR INTERPOLATION WITH APPLICATIONS TO ANALOGUE COMPUTING. E.G.C.Burt and O.H.Lange.
Proc. Instn Elect. Engrs, Monogr. No. 137 M, publ. June, 1955 (Vol. 103 C, 51-8).

Republication of the monograph abstracted in Abstr. 6680 (1955).

519.1 : 539.133

5598. COMBINATORIAL PROBLEMS SUGGESTED BY THE STATISTICAL MECHANICS OF DOMAINS AND OF RUBBER-LIKE MOLECULES. H.N.V.Temperley.
Phys. Rev., Vol. 103, No. 1, 1-16 (July 1, 1956).

The mathematical problem of enumerating the number of connected domains that can be drawn on a plane square lattice is studied by several methods and results that are believed to be very nearly correct for large domains are obtained, while a slightly modified version of the problem can be solved in closed form. Comparison of the various methods tried lead to conclusions which, besides their purely mathematical interest, have a bearing on a large number of physical problems, such as ferromagnetism, order—disorder in alloys, the theory of solutions, fusion and evaporation, the configuration of polymer molecules and gel formation. The comparison of the various methods also gives information on what may be expected of an approximate theory of a phase transition. A.

519.2 : 536.7

5599. GENERALIZATION OF THE EHRENFEST URN MODEL. M.J.Klein.
Phys. Rev., Vol. 103, No. 1, 17-20 (July 1, 1956).

A generalization of the usual Ehrenfest urn model is discussed. The generalization is made by relaxing the condition that the transition probabilities between the two urns are equal. The model is interpreted as a schematic representation of the behaviour of a system in contact with a heat bath at fixed temperature. The stochastic equations for the model are solved by methods used by Kac and the results are interpreted physically. A.

519.272 : 621.3.012

5600. A SIMPLE EXPLANATION OF THE COMPLEX CORRELATION COEFFICIENT. H.J.Linn and K.Pöschl.
Arch. elekt. Übertragung, Vol. 10, No. 3, 105-6 (March, 1956). In German.

The complex correlation coefficient is a measure of the relationship between two complex fluctuating amplitudes. The two complex planes in which the amplitudes are represented are interrelated by complete linear mappings (rotating and stretching transformations). The complex correlation coefficient is then obtained from the complex numbers characterizing the rotating and stretching transformations, in a manner similar to the deviation of the real correlation coefficient from the slopes of the fitted straight lines, using the calculus of observations with measuring series. A.

519.283 : 537.533.8

5601. STATISTICAL PROBLEMS OF AN ELECTRON MULTIPLIER. L.Yanoshi (Jánossy).
Zh. éksper. teor. Fiz., Vol. 28, No. 6, 679-94 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 520-531 (Nov., 1955).

Discusses the problems of obtaining the distribution of the sum of n independent discrete random variables and obtains a solution using the method of steepest descents (see also H.E. Daniels, Annals of Mathematical Statistics, Vol. 25, 631, 1954). The inverse problem of determining the original distribution, given the distribution of the sum, is also considered. N.L.Johnson

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.6 : 621.397.9

5602. TELEVISION TECHNIQUES IN OBSERVATIONAL ASTRONOMY. B.V.Somes-Charlton.
Brit. Commun. and Electronics, Vol. 3, No. 4, 192-6 (April, 1956).

Television techniques can be applied (a) for fast photography of planets, (b) for astrophysical measurements on stars and the intensification of very faint images, such as those of distant galaxies or nebulae, (c) for stellar spectroscopy, particularly in the ultraviolet and infrared regions. Up to the present time, most of the practical work at Cambridge has been on items (a) and (c), as much useful knowledge could be obtained by the use, with minor modifications, of Pye standard television-camera equipment operating under closed-circuit conditions. The image-orthicon equipment used in conjunction with a 12 in. refractor telescope at the Dunsink observatory, Dublin, for demonstrations during the Ninth General Assembly of the International Astronomical Union, is described. With such equipment a large increase in sensitivity is obtained, so that exposure times can be correspondingly reduced and greater definition obtained in the image. Photographs of part of the moon's surface by direct photography (exposure 4 sec) and by television technique (exposure 0.2 sec) are shown which illustrate this. Similar results have been obtained in tests carried out on the planets Jupiter and Saturn. Experiments are in progress with a veiw to reducing still further the exposure time by using a television system operating on 625 lines at 100 frames/sec sequentially, without interlace. Synchronization of the television rate-of-scan with the operation of a photographic shutter should then make it possible for pictures to be taken off the television screen with an exposure of 0.01 sec. A.Wilkinson

522.611 : 523.77

5603. SOLAR SPECTROSCOPY WITH A VACUUM SPECTROGRAPH. R.R.McMath.
Astrophys. J., Vol. 123, No. 1, 1-8 (Jan., 1956).

522.612

5604. ON THE THEORETICAL INSTRUMENTAL PROFILE OF AN ASTRONOMICAL SPECTROGRAPH. A.Kranjc.
R.C. Accad. Naz. Lincei, Vol. 19, No. 5, 301-6 (Nov., 1955). In Italian.

The combination of a reflecting telescope and a spectrograph produces on the plate an image of a spectral line which corresponds to a system of incoherent spherical waves emerging from a long narrow portion of the spectrograph slit. The collimator is not uniformly illuminated on account of the shadow of the Cassegrain mirror in the telescope. Line profiles have been calculated by the methods described, and are shown graphically for four cases. These are (1) the ideal case examined by van Cittert, (2) a combination of Zeiss telescope and spectrograph, (3) the same with uniformly illuminated collimator, and (4) the case with a line image on the slit instead of the point image assumed in (2) and (3). The first three show a point of zero intensity between the first and second diffraction maxima; this point is at different distances from the centre for the three cases. In case (4) there is a minimum in a similar position but it is not zero.
S.T.Henderson

522.615

5605. IMAGÉ CONVERTERS WITH THIN PROTECTING FOILS. II. R.H.Miller, W.A.Hiltner and J.Burns. III.
Astrophys. J., Vol. 123, No. 2, 368-70 (March, 1956).

For previous part see Abstr. 6682 (1955). Additional tests, using a photographic emulsion as the electron-sensitive element, indicate (1) an adequate "half-sensitivity life" for the photocathode viz. 17 days; (2) a final resolution (on the emulsion) of 20-25 lines/mm, with an Ilford X-ray emulsion espe cially sensitive to β-rays, which is adequate for limited appl cations only; (3) a rather large field emission, due to excitation of the photocathode by fluorescent radiation from the gla envelope, which limits the use of the tube to astronomical work requiring relatively short exposures. D.R.Barbe

523.0

5606. ON THE SOLUTION OF EQUATIONS OF TRANSFER. M.Krook.
Astrophys. J., Vol. 122, No. 3, 488-97 (Nov., 1955).

A moment method is given for the approximate solution transfer equations. This is used to discuss the relation between various other methods that are also based on initially approximating to the angular distribution of intensity. The pr cedures most frequently employed are not adapted to the bou ary conditions of the problems. Definite advantages attach tc the use of procedures adapted to the boundary conditions; the discrete-ordinate method, the moment method, and the meth of expansion in orthogonal functions are completely equivalen A

523.03 : 536.7

5607. RADIATIVE TRANSFER AND THERMODYNAMICS. R.Wildt.
Astrophys. J., Vol. 123, No. 1, 107-16 (Jan., 1956).

The irreversibility of radiative transfer is made manifes by analysing the steady-state interaction of the nonisotropic field of nonequilibrium radiation with an isotropic atom gas. It is shown that the practice of substituting the Planck functio for the source function contravenes the second law of thermodynamics. Consideration of the nonequilibrium entropy leads to rather general conjectures regarding the spectral distribut ion of the source function. A

523.03

5608. SOME REMARKS ON THE (U, B, V) SYSTEM. V.M.Blanco.
Astrophys. J., Vol. 123, No. 1, 64-7 (Jan., 1956).

The variations of the total and selective absorptions with respect to spectral intensity distribution and total absorption are determined for the (U, B, V) photometric system. A

523.1

5609. EXPANDING H II REGION. M.P.Savedoff and J.Greene.
Astrophys. J., Vol. 122, No. 3, 477-87 (Nov., 1955).

The gas dynamic effects of star formation inside a unifor extended H I cloud are discussed. The temperature and pressure within the resulting H II region are estimated as two hundred times that in the H I region. It is concluded that the expanding H II region is surrounded by a dense H I region, separated from the undisturbed H I region by a shock front an from the H II region by an ionization front. This dense shell expands outward at about 14 km/sec and is perhaps two hundred times as dense as the undisturbed region. It is estimate that for $n_{H_2} \sim 0.1\, n_H$, any temperature anomaly will disappea after $2 \times 10^4\, n_H^{-1}$ years through interaction with the interstella radiation field; thus in the analysis of the problem the H I region is treated as isothermal. The motions are obtained in an isothermal gas surrounding a sphere whose surface velocit is constant. The relative motion of the ionization and shock fronts is obtained, and it is shown that the compressed shell persists, although the spherical motion is recognized as unstable. Radiation pressure is estimated to be negligible as long as the H II region is closed. These results need not appl to a nonuniform gas. A

523.112 : 530.162

5610. INFORMATION THEORY AND THE EXPANDING UNIVERSE. P.M.Duffieux.
Rev. Opt., Vol. 35, No. 2, 96-102 (Feb., 1956). In French.

The loss of information in the images of distant nebulae is due (i) to "noise" of terrestrial origin (e.g. scintillation) or (possibly) galactic origin, and (ii) to the increase of wavelength of light associated with the "expanding universe". If this change in wavelength is supposed due to Doppler effect of the motion of the nebula relative to Galilean axes, then the transmission of information between object and observer must be completely reversible. If such a reversibility is not accepted, then the loss of information must be due to some order–disorder process acting on the photons between object and observer, this process being irreversible and associated with a loss of energy. M.W.Ovenden

523.161

5611. ON THE OPTICAL PROPERTIES OF INTERSTELLAR DUST. J.R.Platt.
Astrophys. J., Vol. 123, No. 3, 486-90 (May, 1956).

Solid particles of less than 10 A in radius grown by random accretion from interstellar gas would be expected to be generally opaque and highly reflecting in the visible region and paramagnetic and quasimetallic, even if formed from light atoms, because their energy bands will, in general, be unfilled. Their ellipticity and optical anisotropy is estimated. It appears that interstellar reddening and polarization might be explainable by the quantum-mechanical optical and statistical properties of such tiny particles, with normal cosmic composition, provided that they have random geometrical and electronic structure. A.

523.161 : 535.514.9

5612. INTERSTELLAR POLARIZATION OF LIGHT. S.B.Pikel'ner.
Uspekhi fiz. Nauk, Vol. 58, No. 2, 285-320 (1956). In Russian.

Review of experimental data and discussion of the properties of interstellar gas and dust, the polarization of light by orientated particles, a mechanism for the orientation of the particles, the properties of magnetic fields. Magnetic fields are thought to be the basic factor accounting for this and certain other astrophysical phenomena. 54 refs. C.R.S.Manders

523.162 : 523.164.4

5613. ABSORPTION OF 21-cm RADIATION BY INTERSTELLAR HYDROGEN. J.P.Hagen, A.E.Lilley and E.F.McClain.
Astrophys. J., Vol. 122, No. 3, 361-75 (Nov., 1955).

Absorption effects have been observed in the continuous microwave noise spectra of certain radio stars. The absorption is produced by the F = 0 to F = 1 hyperfine transition in interstellar hydrogen and occurs at a wavelength of approximately 21 cm. For radio stars and interstellar H I, the effect is similar to the presence of optical interstellar absorption lines in stellar spectra. Three absorption-line components due to interstellar H I are found in the microwave spectrum of the Cassiopeia source. The absorption lines are characterized by their narrow breadth and do not necessarily coincide with the gross 21 cm emission maxima of the same region. The physical interpretation of the absorption profiles is sensitive to the manner in which the H I is distributed in the interstellar medium. The analysis strongly supports the distribution of H I in clouds or in condensations in a less dense medium. Distances to the absorbing clouds and minimum distances to the discrete sources may be determined from a galactic-rotation analysis of the absorption profiles. A minimum distance to the Cassiopeia A discrete source of 3 kpsc is found. A.

523.162

5614. CONSTANCY OF THE ABSORBING PROPERTIES OF INTERSTELLAR MATTER. A.M.Rozis-Saulgeot.
C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 1959-60 (April 16, 1956). In French.

The apparent change in the law of interstellar absorption indicated by the results of 3-colour photometry of stars in the Cygnus region (Johnson and Morgan, 1955) may be explained as a direct consequence of an influence of filter band-width, as distinct from effective wavelength, on the colour-excess ratio (U-B)/(B-V), without postulating the existence of anomalous interstellar reddening in this region. D.R.Barber

523.164

5615. THE INTERFEROMETRIC STUDY OF BRIGHTNESS DISTRIBUTION IN RADIOASTRONOMY. I. J.Arsac.
Rev. Opt., Vol. 35, No. 2, 65-95 (Feb., 1956). In French.

A general development of the theoretical basis of the determination of brightness distribution across the sky by aerial arrays, which begins with a study of the reception by a single directive aerial. Special attention is paid to the design of "incomplete arrays" which receive the maximum number of harmonics for a given number of aerials in the array, and to the errors introduced in the deduction of the brightness distribution from the observed signal by representing the distribution function as a polynomial. Observations of the sun on 9350 Mc/s with (a) a two-aerial system, and (b) a 0,1,4,6 array are taken as numerical examples. M.W.Ovenden

523.164.32

5616. RADIO REFLECTION AND REFRACTION PHENOMENA IN THE HIGH SOLAR CORONA. R.N.Bracewell and G.W.Preston.
Astrophys. J., Vol. 123, No. 1, 14-29 (Jan., 1956).

At the lowest frequencies used in radio astronomy, e.g., at 18 Mc/s, the sun has not yet been observed; but if existing data are correct, it presents a number of curios features; (a) the size of the sun as a radio-frequency source is two to three times the size of the visible sun, but in place of a sharp limb, there is merely a gradual fading-away into the background; (b) a zone of sky is occulted by the sun, and, because significant effects of refraction reach farther out into the corona than the effects of absorption, the occulted zone is some nine times larger than the photosphere; (c) the sun exhibits an occulting disk whose diameter is six times that of the photosphere and which differs from the emitting disk in having a sharp limb; (d) the discrepancy in size between the occulted zone and the occulting disk is associated with apparent displacement of the unocculted sky toward the sun by refraction; (e) within the occulting disk the sun behaves as a convex reflector, mirroring the whole of the unocculted sky. The reflection of the Galaxy, though greatly diminished in size, remains comparable as a radio source with the emitting sun itself. If observed with existing aerials, which are incapable of resolving the solar emission from the galactic reflection, the sun should apparently exhibit a marked annual variation of flux density. A.

523.164.32

5617. WHAT DO WE SEE OF THE CORONA IN FRONT OF THE SOLAR DISK? M.Waldmeier.
Z. Astrophys., Vol. 38, No. 3, 143-59 (1955). In German.

The observed intensity-decrement for the inner coronal lines, whose emission is proportional to N_e^2, permits the shape of the radio-corona to be computed with results in satisfactory agreement with radio-observations. The analysis yields also the pattern of the corona, as projected on the solar disk. Bright emission zones are found around E and W limbs, with lowered intensities over the polar, and central regions of the disk. D.R.Barber

523.164.32

5618. ON THE LIMB-DARKENING OF SOLAR RADIO-FREQUENCY RADIATION. H.Müller.
Z. Astrophys., Vol. 39, No. 3, 160-87 (1956). In German.

The limb-darkening function for solar radiation for various frequencies between 62 and 1200 Mc/s has been found from data published in the Quarterly Bulletin of Solar Activity, 1947-52. On all frequencies, the function has a slope so steep that the intensity has dropped to 20-30% of maximum two days after the central meridian passage of the associated solar feature. It is found impossible to explain the observations by either perspective effect or general coronal absorption. It is suggested that the source of radiation is a small dense region within a coronal condensation, the absorption taking place in the surrounding condensation. M.W.Ovenden

523.164.4

5619. NONTHERMAL RADIO EMISSION OF THE GALAXY AND THE ORIGIN OF COSMIC RADIATIONS. C.Y.Fan.
Astrophys. J., Vol. 123, No. 3, 491-7 (May, 1956).

Based on the general scheme of Fermi's theory of the origin of cosmic radiation, the possibility of the acceleration of high-energy electrons required for the production of the nonthermal radio emission of the Galaxy is investigated. It is found that the energy spectrum of these electrons assumes the form of $(w_m - w)^{s-1}/(w - w_i)^{s+1}$, where w_m is the maximum energy attainable and w_i is the minimum initial energy (the injection energy) for which an electron can be accelerated. A particular set of data which is compatible with the present knowledge of the galactic structures yields w_m = 14 BeV, w_i = 0.06 BeV, and s = 1.6. The total number of such high-energy electrons sufficient for the production of the observed intensity of radio emission is of the order of $10^{-12}/cm^3$. The spectrum of the radio emission is $1/\nu$ when the tentatively chosen data are used. These results seem to be compatible with observations. A.

523.164.4

5620. OBSERVATIONS OF AN ECLIPSE OF THE CRAB NEBULA. A.Boischot, E.J.Blum, M.Ginat and E.Le Roux.
C. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1849-52 (April 9, 1956). In French.

Observations on 169 and 900 Mc/s of the eclipse of the Crab nebula by the Moon on 1956 January 24 are reported, and dimensions of the source compared with the visible nebulosity. The precise agreement between the radio and optical centres shows that the lunar refraction cannot exceed 5". M.W.Ovenden

523.164.42

5621. AN APPROXIMATE DISTANCE DETERMINATION FOR RADIO SOURCE SAGITTARIUS A. E.F.McClain.
Astrophys. J., Vol. 122, No. 3, 376-84 (Nov., 1955).

Radio source Sagittarius A (IAU 17S2A) lies very close to the predicted centre of the Galaxy. Hydrogen absorption measurements at a wavelength of 21 cm reveal that hydrogen gas is present between the sun and the source as well as beyond the source. An independent distance scale has been obtained by assuming a constant thickness for the hydrogen gas and by relating the angular extent of the gas to its radial velocity. Using a thickness of 240 parsec for the Galaxy, the radio source is found to have a probable distance of 3 or 4 k-parsec. Source 17S2A is therefore thought to be complex and to consist of a rather intense discrete source superimposed on the broad central galactic background. A.

523.164.42 : 523.162.2

5622. THE HYDROGEN-LINE RED SHIFT OF RADIO SOURCE CYGNUS A. A.E.Lilley and E.F.McClain.
Astrophys. J., Vol. 123, No. 1, 172-5 (Jan., 1956).

A measure of the red shift has been obtained on radio source Cygnus A by means of the hydrogen-line absorption effect in the continuous microwave spectrum of the source. The measured microwave red shift agrees in magnitude with the optical red shift, and, within the limits imposed by the experiment, $\Delta\lambda/\lambda$ is constant over an interval of 500 000 to 1 in the electromagnetic spectrum. A

523.164.42 : 523.162.2

5623. A NOTE ON THE POTENTIALITIES OF LARGE RADIO TELESCOPES. E.F.McClain.
Astrophys. J., Vol. 123, No. 2, 367-8 (March, 1956).

An analysis of the factors limiting the observation of absorption of neutral hydrogen in extragalactic objects (see preceding abstract) leads to an estimated 1000-2000 extragalactic sources for which such observations would be possible with a 500 ft diameter aerial. Such an aerial would also detect intergalactic neutral hydrogen of a density $\sim 10^{-29} g/cm^3$. M.W.Ovenden

523.164.4

5624. THE ANGULAR SIZE OF THE VARIABLE RADIO SOURCE HYDRA-A. A.W.L.Carter.
Austral. J. Phys., Vol. 8, No. 4, 564-7 (Dec., 1955).

The Hydra-A source has been observed on 101 Mc/s with a 3-aerial linear array giving pair-spacings of about 90, 900 and 1000 wavelengths. The parameters of temperature, angular size and intensity are deduced for a model with circular symmetry and a Gaussian distribution of radial intensity. Variations of intensity ~20-30 per cent of the mean value are confirmed, and variations of angular size between 1.0' and 2.0' found. From the discussion of these observations, it is suggested that a considerable part of the apparent surface of the source must exhibit variations in brightness, and that an estimated maximum distance from the sun of the region in which the variations occur of 2 parsecs is unlikely to be seriously in error. M.W.Ovenden

523.164.4

5625. RADIO OBSERVATIONS OF INTERSTELLAR NEUTRAL HYDROGEN CLOUDS. R.S.Lawrence.
Astrophys. J., Vol. 123, No. 1, 30-3 (Jan., 1956).

A detailed relationship is found to exist between optical interstellar absorption lines and 21 cm observations. Six stars not in the vicinity of the galactic plane were selected from a list of stars which exhibit complex absorption spectra of Ca II. In the directions of two of these stars a weak hydrogen line appears, which agrees in radial velocity with an intense component of the optical spectrum. A

523.164.8

5626. THE DURATION OF FORWARD-SCATTERED SIGNALS FROM METEOR TRAILS. P.A.Forsyth and E.L.Vogan.
Canad. J. Phys., Vol. 34, No. 6, 535-45 (June, 1956).

The durations of radio signals obtained by forward scattering from meteor trails have been determined by direct measurement, using moving chart, amplitude recordings. The recordings were made simultaneously at two frequencies and similar measurements were made on signals received over two transmission paths in western Canada. The durations of signals observed over an east—west path appear to be greater than those observed over a north—south path. The observed dependence of duration upon both wavelength and equipment sensitivity is compared with that found previously by McKinley for back-scattered signals. Effects similar to those found by McKinley are present in the forward-scatter data. The method used to record the signals makes possible a more detailed examination of these effects. While the dependence of duration upon equipment sensitivity seems to be in accord with the presently accepted theories of meteor scattering, the dependence upon wavelength is not yet completely understood. A

523.165 : 523.042

5627. A POSSIBLE EFFECT OF COSMIC RAYS ON CELESTIAL CHEMICAL COMPOSITION. S.Hayakawa.

Progr. theor. Phys., Vol. 13, No. 4, 464-5 (April, 1955).

Assuming an average solar cosmic-ray (C.R.) intensity $J = 10\,sec^{-1}\,cm^{-2}$ at the surface of the sun, and assuming a cross-section $\sigma \sim 10$ mb, it is pointed out that a fraction $f = J\sigma TF$ ($\sim 10^{-8}$ F) of the heavy elements of abundance F are transformed into light elements during the time, $T \sim 10^{17}$ sec, of the existence of the sun. If there exist more efficient C.R. producers than the sun (e.g. possibly supernovae, known to be rich in heavy elements), sizeable nuclear transformations due to C.R. may take place. The presence of elements other than those produced by thermonuclear reactions is thus possible. On the other hand, the absence of the element Tc in nature, when it occurs with normal frequency among fission products, suggests that C.R. may only be able to alter the fine structure of the abundances. R.H.W.Johnston

523.53 : 523.164.85

5628. RADIO DETERMINATION OF THE ORBIT OF THE ETA AQUARID METEORS. D.W.R.McKinley.
Astrophys. J., Vol. 122, No. 3, 513-19 (Nov., 1955).

From an analysis of radio-echo data obtained on May 4-5, 1949, the mean observed velocity of the η-Aquarid meteors is determined to be 64.4 km/sec, and the corrected geocentric velocity to be 64.6 km/sec. A position at R.A. 330°, Dec. 0°, is found for the η-Aquarid radiant. With these data an orbit was computed with an eccentricity of 0.83, an inclination of 157°.8, and a period of 8.0 years. Some further remarks on the δ-Aquarid shower of July, 1949, are appended, and the observed velocity is corrected to give a geocentric velocity of 40.9 km/sec for the δ-Aquarid meteors. A.

523.59

5629. RECORDINGS OF THE ZODIACAL LIGHT. V.H.Regener.
Astrophys. J., Vol. 122, No. 3, 520-9 (Nov., 1955).

A series of 47 photoelectric recordings of the zodiacal light in the form of isophote maps has been obtained for 24 nights from March, 1953, until May, 1954. Only white light, not resolved into polarized and nonpolarized components, was used. The optical equipment consisted of an equatorially mounted reflector of 60 in. aperture with a phototube at its focus. This reflector scanned the sky automatically in the region of the zodiacal light, while values of light-intensity were recorded simultaneously on a map of the sky in equatorial co-ordinates. Such a map allowed the immediate plotting of isophotes, the convenient application of atmospheric corrections, and a rapid transfer of the data to the ecliptic co-ordinate system. During the recording period the cone of the zodiacal light shows a high degree of symmetry with respect to the ecliptic. No significant time variations of any of the measured characteristics of the zodiacal light are detected. An empirical analytic expression is given for the intensity of the zodiacal light in a limited region of the sky. A.

523.72

5630. A SEARCH FOR SOLAR VARIATION. R.H.Hardie and H.L.Giclas.
Astrophys. J., Vol. 122, No. 3, 460-5 (Nov., 1955).

Photometric observations of Uranus and Neptune made from 1949 to 1954 are presented and discussed in relation to possible variations in the visible solar radiation. These point to the unlikelihood of any variations in excess of about 0.004 mag. during this time. The techniques which have been used to attain high accuracy are described. A.

523.72 : 537.591.5

ANOMALOUS INTENSITY INCREASE OBSERVED AT SACLAY ON FEBRUARY 23rd, 1956. See Abstr. 5197

523.743

5631. ON THE SOLAR GRANULES. M.S.Uberoi.
Astrophys. J., Vol. 122, No. 3, 466-76 (Nov., 1955).

The granule data are analysed to show that all the characteristics of present-day measured solar brightness fluctuations (granules) are almost entirely determined by the instruments used to measure them. For example, the measured intensity and scale of the granules are not even close to the actual value. The analysis shows that the spectrum of the brightness fluctuations extends over a much wider range than that covered by any telescope thus far used to measure solar granules. The previous work on the subject is critically examined. It appears that, independent of the resolving power, some of the conclusions drawn by other investigators are open to objections. A.

523.746

5632. ON THE CONSTANCY OF THE SUNSPOT RELATIVE-NUMBER SCALE. W.Gleissberg.
Naturwissenschaften, Vol. 43, No. 9, 196 (1956). In German.

Waldmeier's statistical sunspot relation, F = a.R, where F is the annual mean of the daily total area, R is the annual mean of the daily relative number, and a is equal to 16.7, has been examined in relation to observational data for the years, 1878-1953. It is found that the mean value of the factor of proportionality, a, taken over a 19-year period, is not constant but varies between the limits, 15.76 and 16.52, both lower than Waldmeier's value above. This indicates a change of scale value (of R) with epoch, which is supported by a systematic dependence of a on R, the factor a increasing from a min. of 12.25 for $R < 13.5$ to a max. of 16.51 for $R > 64.5$. D.R.Barber

523.75

5633. THE HELIUM EQUILIBRIUM IN PROMINENCES AND THE CHROMOSPHERE. H.Zirin.
Astrophys. J., Vol. 123, No. 3, 536-43 (May, 1956).

The equilibrium of helium in a gas suspended above the photosphere is analysed by computing in detail the various atomic processes involved and writing down the equilibrium equations. These equations are solved for the occupation numbers of He III, He II, and the various important He I levels, in order to predict the relative intensity of helium lines. The triplet levels are in equilibrium (referred to the 2^3S state) with the photospheric radiation with the proper dilution factor. This gives good agreement with the 5876/10830 ratio measured by Severny. Particular attention is paid to the ratio of the lines 6678/5876. This is found to vary with temperature only, and the observed ratio should be a good measure of the temperature of helium. A.

523.755

5634. A PHOTOMETRIC STUDY OF THE SOLAR CORONA. N.Hepburn.
Astrophys. J., Vol. 122, No. 3, 445-59 (Nov., 1955).

Photometric measurement of the solar corona as photographed by the Naval Research Laboratory expedition to Khartoum, Sudan, on February 25, 1952, is described and related to other measurements and theoretical studies. In particular, the variation of white-light intensity with radius is compared to van de Hulst's model of the corona, and coefficients are derived for his equations which produce curves more nearly fitting the observed intensities. The removal of the F-corona and calculation of electron densities according to van de Hulst's model appears to give consistent results here. These measurements extend from the solar limb out to about 2.5 solar radii from the centre of the sun, so that combination of the results with those obtained by the French expedition to Khartoum (headed by Bernard Lyot) is of considerable interest. A comparison has been made between their measurement of the variation with the position angle of the red and green coronal lines near the great streamer and variations in the white-light corona. Although the centre of the streamer appears to lie about 10° north of the emission-line maximum, an examination of the white-light corona near the limb ($\rho = 1.06$) shows a close correlation of white-light intensity with the emission lines. A.

523.755

5635. SYNOPTIC CHARTS OF THE SOLAR CORONA. M.Waldmeier.
Z. Astrophys., Vol. 38, No. 4, 219-36 (1956). In German.

Heliographic charts based on daily observations, 1938-1955, give the distribution of intensity over the solar disk of the principal coronal emissions at 5303, 5694, and 6374 A; their height above the disk; and the distribution of electron density, and temperature. The line at 5303 A is especially intense over spots and faculae; and that at 5694 A is strongly associated with large, active spot-groups. The emission at 6374 A is distributed over the whole disk, being enhanced over plages and sunspots; there is also a significant reduction of line intensity for this wavelength in the neighbourhood of filamentary structures. D.R.Barber

523.76

5636. MODEL ATMOSPHERES AND THE SOLAR CONTINUUM. T.L.Swihart.
Astrophys. J., Vol. 123, No. 1, 143-50 (Jan., 1956).

Standard models of the solar atmosphere are constructed, and their continua are compared with observations of the solar continuum. Three possible sources of the differences are investigated. It is found that deviations from the Kirchhoff–Planck relation are negligible. Convection improves the theoretical fluxes and intensities by a small amount, but it also causes the values of the limb darkening to be more discordant with the observations. An evaluation of the continuous absorption of the metals in the ultraviolet, by means of a formula which leaves uncertainty, shows promise in reproducing the observations. A.

523.77

5637. DOPPLER SHIFTS IN SOLAR GRANULES. R.R.McMath, O.C.Mohler and A.K.Pierce.
Astrophys. J., Vol. 122, No. 3, 565-6 (Nov., 1955).

It is noted that the solar Fraunhofer lines, in contradistinction to atmospheric water-vapour lines, exhibit both visually and photographically, transient irregularities due to local Doppler shifts in the solar image projected on the spectrograph slit. Maximum observed values are ~0.5 km/sec from the mean velocity, with a dispersion of 0.2 km/sec. These shifts in the 1-2 second granules, and line-displacements of 5 to 15 seconds of arc along the slit, will introduce errors into the determination of the solar rotation: also they will impose localized errors on interferometric evaluations of wavelength when using a solar image focused on the ring-system. D.R.Barber

523.77

5638. AN INVESTIGATION OF FAINT LINES IN THE SOLAR SPECTRUM BETWEEN 5000 AND 6000 A. R.Zalubas.
Astrophys. J., Vol. 123, No. 3, 544-8 (May, 1956).

In the solar spectrum between 5000 and 6000 A, 234 new faint lines are recorded, and 4072 lines, which are present in the second revision of Rowland's Table (now in progress) have been remeasured. The present measurements have been compared with the Rowland lines retained in the second revision and with the Utrecht Atlas. The number of lines to be omitted as unreal makes only 1.5% of the total; therefore, it is concluded that there are almost no spurious lines in the Revised Rowland in this interval. A.

523.774

5639. THE THEORY OF CURVES OF GROWTH. K.Hunger.
Z. Astrophys., Vol. 39, No. 1, 36-60 (1956). In German.

With the aid of Milne–Eddington, and Schuster–Schwarzschild models, the roles of "pure absorption" and "coherent scattering" in the formation of Fraunhofer lines are examined and the results applied to a theoretical estimate of line intensities at the centre of the solar disk. D.R.Barber

523.775

5640. PRELIMINARY NOTE ON MEASURES OF CORONAL EMISSION LINES OBSERVED AT THE TOTAL SOLAR ECLIPSE, FEBRUARY 25, 1952, BY B.LYOT AND M.K.ALY. M.K.Aly.
Astrophys. J., Vol. 122, No. 3, 438-44 (Nov., 1955).

The Egyptian mission for the total solar eclipse of 1952 at Khartoum undertook this present work at the suggestion of the late Bernard Lyot of Meudon, and carried it out jointly with M.K.Aly of Helwan. For this purpose, two spectrographs were designed for observing the coronal emission lines close to the sun's limb over the whole range of the spectrum from λ 6900 to λ 3100. A short account of the programme is followe by a description of the plates obtained, and the wavelength measurements of all the coronal lines seen on the plates. In addition to most of the previously discovered emission lines observed at earlier eclipses, some thirteen new lines were observed at this eclipse. A.

523.775

5641. CLASSIFICATION OF EMISSION LINES λ 5694 AND λ 5446 IN THE SOLAR CORONA. F.Rohrlich.
Astrophys. J., Vol. 123, No. 3, 521-31 (May, 1956).

The contradictions in the literature concerning the theoretical classification of these coronal lines are resolved, and the experimental result: Ca xv: $2s^22p^2$, $^3P_2 - {}^3P_1 \rightarrow \lambda$ 5446; Ca xv: $2s^22p^2$, $^3P_1 - {}^3P_0 \rightarrow \lambda$ 5694, is confirmed. The semi-empirical parameters associated with the Ca xv spectrum are obtained on the basis of the linear theory with configuration interaction in intermediate coupling. The parameter set used by Layzer (1954) is criticized. A.

523.775

5642. CORONAL TEMPERATURE DETERMINATION FROM EMISSION LINES. D.E.Billings, S.Hirsch and C.Varsavsky.
Astrophys. J., Vol. 123, No. 3, 532-5 (May, 1956).

Coronal temperatures derived from widths of emission lines are compared with those derived from the relative brightness of the lines. In the majority of cases studied, temperatures from the two methods showed a definite correspondence, indicating that the widths of the coronal lines are primarily thermal. A.

523.775

5643. ABSOLUTE CALIBRATION OF THE CLIMAX INTENSITY SCALE FOR CORONAL LINES. D.E.Billings and C.M.Varsavsky.
Z. Astrophys., Vol. 38, No. 3, 160-5 (1955).

Tables are given for converting coronal line intensities (at 5303 A and 6374 A), on the Climax arbitrary scale, to equivalent angstroms for four levels of sky-brightness viz. 22, 51, 85 and 137 millionths of solar-disk brightness. The relationship between Climax intensities and those measured at Pic du Midi and Wendelstein is discussed. D.R.Barber

523.78

5644. THE TOTAL ECLIPSE OF THE SUN, FEBRUARY 25, 1952. LIGHT-CURVE NEAR MID-ECLIPSE. C.C.Batchelder, K.Batchelder, R.Hargreaves and J.Hargreaves.
Astrophys. J., Vol. 123, No. 1, 9-13 (Jan., 1956).

Observations obtained with an electric telephotometer during the total eclipse of February 25, 1952, show (1) that the light-curve was not symmetrical before and after mid-eclipse; (2) that during totality the luminance of the sky varied with time and zenith distance; and (3) that the zenithal intensities were equal at mid-eclipse and when the sun was at 95° 28' zenith distance, during evening twilight of the same day. It is suggested that for this eclipse the terrain over which the penumbra passed was an important cause of the irregularities noted. A.

523.838

5645. INVESTIGATIONS OF ROTATING STARS. I. ZERO-ORDER THEORY. R.Kippenhahn.
Z. Astrophys., Vol. 38, No. 3, 166-89 (1955). In German.

A differential equation is set up for the angular velocity ω, neglecting terms of order $\bar{\omega}^2/2\pi G\bar{\rho}$. To this approximation, rotational distortion and circulation currents may be neglected, and the structure of the star is not affected by rotation. On account of the effect of momentum transport by the radiation current, there are no solutions corresponding to stationary spherically symmetric motion, but the assumption $\omega = \omega(r)e^{-\lambda t}$ leads to an eigenvalue problem for λ. Illustrative calculations made for a standard model B4 star give an angular velocity at the centre about nine times that at the surface. The eigenvalue problem is also formulated for the case $\omega = \omega(r, \theta, t)$ and it is concluded that motion will tend to become spherically symmetric independently of initial conditions. A discussion of the applicability of the present results shows that for most stars a higher-order theory would be required.
R.A.Newing

523.838

5646. ANGULAR MOMENTUM TRANSPORT BY MAGNETIC FIELDS AND THE BRAKING OF ROTATING STARS.
R.Lüst and A.Schlüter.
Z. Astrophys., Vol. 38, No. 3, 190-211 (1955). In German.

The conditions under which angular momentum can be transported by axially symmetric magnetic fields are discussed. Such transport is found to be possible in the case of "angular momentum-free" magnetic fields, i.e. fields for which the transverse component of $\vec{H} \times \text{curl}\,\vec{H}$ is zero. Calculations made for the sun indicate an annual fractional decrease in angular momentum of about 10^{-9}. The application of the theory to the evolutionary development of a star is considered, and it is concluded that the transport provides an effective mechanism for the braking of initially rapidly rotating stars. The possibility of transport by force-free fields is also considered; transport by the simple fields previously considered (Abstr. 3902/1954) is shown not to be possible, but no conclusion is arrived at in the case of general fields of this type.
R.A.Newing

523.852.2 : 523.872

5647. GASEOUS NEBULAE. L.H.Aller.
London: Chapman and Hall (1956) xvi + 322 pp. (The International Astrophysics Series, Volume three).

This book provides a comprehensive survey of the observational and theoretical investigations of gaseous galactic nebulae, and an authoritative and lucid account of the present state of development in this field. A critical discussion and evaluation of observational techniques includes a consideration of photoelectric and calibrated photographic photometry, and a detailed survey is given of present knowledge of the distances, dimensions and spectra of planetary and diffuse nebulae. Full consideration is given to the theory of radiative and excitation processes in ionized gases, and forbidden line radiation is discussed in great detail. There are many useful plates and tables throughout the text. The chapter headings are: (1) Types of gaseous nebulae; (2) Methods of observation; (3) The distances, dimensions and spectra of the gaseous nebulae; (4) Physical processes in gaseous nebulae; (5) The forbidden lines; (6) The stars that illuminate the gaseous nebulae; (7) Structure and internal motions of the planetary nebulae; (8) The diffuse gaseous nebulae. Each chapter is followed by a comprehensive list of references, and there are extensive author and subject indexes.
R.A.Newing

523.872 : 535.338.334

5648. THE DEBYE–HÜCKEL EFFECT AND STATISTICAL THEORIES FOR COLLISION BROADENING. F.N.Edmonds, Jr.
Astrophys. J., Vol. 123, No. 1, 95-106 (Jan., 1956).

The theory of Debye and Hückel for electrolytes is shown to be valid and pertinent for ionized gases of astrophysical interest. Corrections to statistical theories of collision broadening due to the Debye–Hückel effect are shown to be negligible in the cases of linear and quadratic Stark broadening of the spectral lines of ions. In an appendix, Debye–Hückel effect corrections are calculated for the related problem of the average distance to the nearest charged particle.
A.

523.872 : 535.33.03

5649. LABORATORY EXCITATION OF THE BLUE-GREEN BANDS OBSERVED IN THE SPECTRA OF N-TYPE STARS.
B.Kleman.
Astrophys. J., Vol. 123, No. 1, 162-5 (Jan., 1956).

A complex band spectrum has been excited in a King furnace charged with silicon. The main features of the spectrum agree with those of the hitherto unidentified blue-green bands occurring in the spectra of some N-type stars. It is concluded from the complexity of the bands that the emitter is a polyatomic molecule. On the basis of a partial vibrational analysis and the experimental conditions for producing the bands, as well as the appearance in the spectra of cool carbon stars, the spectrum is tentatively ascribed to an Si-C-C molecule.
A.

523.872

5650. COMPUTATION OF ABSORPTION LINES IN STELLAR SPECTRA. H. van Regemorter.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2302-5 (May 7, 1956). In French.

The "saturation function", developed by Pecker (1951) for computing equivalent widths of solar lines, is used to derive a generalized "weight-saturation function" method which allows a rapid calculation of the equivalent width of a stellar absorption line of unrestricted intensity.
D.R.Barber

523.872

5651. DENSITY, HERTZSPRUNG–RUSSELL DIAGRAM, AND VELOCITY DISTRIBUTION OF STARS WITHIN 20 PARSECS. W.Gliese.
Z. Astrophys., Vol. 39, No. 1, 1-35 (1956). In German.

Results of observations of 857 single-, double-, or multiple-star systems, including 1022 component bodies. Counting each component as one star, the number-density within a distance of 20 psc is at least 0.15/psc^3, corresponding to a mass-density of 0.057 $\odot$/psc^3, or 3.9×10^{-24} g/cm^3. Single stars, with proper motions of 60 km/sec or less, lie within $\pm$ 0.2 mag. of the main sequence on a H–R diagram; and double stars, and fast-moving systems (up to 100 km/sec) conform to the mean position for spectral type, but with greater dispersion in magnitude. The fastest moving stars lie, on the average, about 0.24 mag. below the main sequence stars. The velocity of the sun, relative to a representative group of 144 K7 to M2 dwarfs is 20 km/sec.
D.R.Barber

523.872

5652. THE APPLICATION OF THREE-COLOUR PHOTOMETRY IN STELLAR STATISTICS. U.Steinlin.
Z. Astrophys., Vol. 39, No. 3, 210-18 (1956). In German.

A trichromatic colour-index diagram (based on red, green and u.v. stellar magnitudes) is used to show: (a) statistical agreement between observed and empirically predicted positions of milky-way stars, with and without absorption; and (b) the place of optical and physical double-stars in the diagram.
D.R.Barber

523.877

5653. RELATIVE ABUNDANCES AND ATMOSPHERIC CONDITIONS IN THE MAGNETIC STAR HD 133029.
E.M.Burbidge and G.R.Burbidge.
Astrophys. J., Vol. 122, No. 3, 396-408 (Nov., 1955).

A spectrophotometric study of HD 133029 has been made, based on nine medium-dispersion coudé spectrograms obtained at the McDonald Observatory. A table of equivalent widths of about 350 lines is given. No evidence of line-intensity variations through the period of observations has been found. There are no detectable radial-velocity differences between the dif-

ferent elements and no significant variations during the period of the observations; if there is any variation with a period of ~ 1½ days (corresponding to a possible magnetic period suggested by Babcock), its total amplitude does not exceed 5 km/sec. From curves of growth it is found, by comparison with the magnetic variable α^2 C Vn, that $T_{ion} = 8000^0$, $T_{exc} = 8000^0$, and the mean total apparent velocity is 4.9 km/sec; it is possible that about 1 km/sec of this is really due to the magnetic intensification effect. Si, Cr, Sr and Zr are overabundant by factors of 25, 10, 16 and 38, respectively; Ca is underabundant by a factor of 20; La and the rare earths are overabundant by a mean factor of 390. These results confirm those in α^2 C Vn, although in some cases the differences between the two stars are significant. It is suggested that the majority of the anomalies are due to surface nuclear reactions, although the small overabundance of Fe, if real, requires a different explanation, possibly connected with the early condensation history of the star. The possible effect of a hydromagnetic turbulent zone into which we are looking is discussed. A.

523.877

5654. NEAR THERMODYNAMIC EQUILIBRIUM. II. L.G.Henyey and W.Grasberger.
Astrophys. J., Vol. 122, No. 3, 498-507 (Nov., 1955).

The concept of near thermodynamic equilibrium (Henyey 1946), is extended to include the effect of collisions in redistributing atoms over a broadened state. Modified expressions are derived for the absorption and emission coefficients. The question of the importance of effects arising from near thermodynamic equilibrium in the deep interior is considered. No change in the usual expression for the flux is required. A.

523.877

5655. THE EQUILIBRIUM OF MAGNETIC STARS. P.H.Roberts.
Astrophys. J., Vol. 122, No. 3, 508-12 (Nov., 1955).

A study is made of the mechanical equilibrium of bodies of incompressible fluid lying in a magnetic field. It is supposed that the system is symmetric about an axis. It is shown that, under certain simplifying assumptions, a series expansion can be derived for the equation of the free surface. A.

523.877

5656. DIMENSIONS OF CONTACT SURFACES IN CLOSE BINARIES. G.P.Kuiper and J.R.Johnson.
Astrophys. J., Vol. 123, No. 1, 90-4 (Jan., 1956).

The calculated dimensions are given of the innermost and outermost equipotential contact surfaces for close binaries of different mass ratios. They are based on the Roche model. A.

523.877

5657. MODEL ATMOSPHERES. T.L.Swihart.
Astrophys. J., Vol. 123, No. 1, 139-42 (Jan., 1956).

A method is considered for correcting model stellar atmospheres so that the integrated flux conditions are satisfied. The method is applied to the sun and to a dwarf star of approximate spectral type F5. It is found that after only two integrations the desired distribution of flux with depth can be reproduced with an accuracy of about 1%. Since the method is not restricted to cases in which the integrated flux is constant with depth, it can be applied to problems considering convection and the blanketing effect. A.

523.877

5658. MODEL ATMOSPHERES WITH HIGH HYDROGEN–METAL RATIO. T.L.Swihart.
Astrophys. J., Vol. 123, No. 1, 151-3 (Jan., 1956).

In an attempt to represent the atmospheres of F-type subdwarfs, two model atmospheres with large values of the hydrogen–metal ratio were constructed. For both the solar and the F5 dwarf models, the continuous spectra were very insensitive to rather large changes in the hydrogen–metal ratio; however blanketing and the continuous absorption of the metals were not included in the calculations. Since both effects tend to depress the ultraviolet, this may be an explanation of the ultraviolet excess of the subdwarfs, if the latter differ from normal stars in the metal content only. A

523.877

5659. MODEL ATMOSPHERES FOR A-TYPE STARS. K.Osawa.
Astrophys. J., Vol. 123, No. 3, 513-20 (May, 1956).

Model stellar atmospheres with $T_e = 8900^0$ and 7560^0 and $\log g = 3.5$, 4.0, and 4.5 are calculated, taking into account the continuous absorption by H, H^-, and H_2^+. The constancy of the net flux is secured to about 1%. The colours and Balmer discontinuities of these models are consistent with the observations for A3 and A9 stars. The profiles of Hγ are calculated and compared with observations. It is possible to interpret qualitatively the empirical luminosity effect of Balmer lines for A-type stars. A.

523.877

5660. ON A LOWER LIMIT FOR THE MAXIMUM DENSITY OF A ROTATING GASEOUS MASS. G.Armellini.
R.C. Accad. Naz. Lincei, Vol. 19, No. 3-4, 102-7 (Sept.-Oct., 1955). In Italian.

A generalized Emden equation is established for globular or annular polytropic masses rotating in relative equilibrium with angular velocity ω. It is shown that there is a point at which the density is greater than $(n + 1)\omega^2/2\pi G$, where n is the polytropic index. R.A.Newing

523.877

5661. ON THE ADIABATIC GRADIENT OF A MIXTURE OF HELIUM AND RADIATION. A.Martini and A.Masani.
R.C. Accad. Naz. Lincei, Vol. 19, No. 5, 292-4 (Nov., 1955). In Italian.

In view of recent observational results, revealing the existence of several hydrogen-poor stars with no evidence for expanding envelopes, the calculations of a previous paper (Abstr. 7407/1953) are extended to the case of a pure helium atmosphere in the range $4.4 < \log T < 4.7$ and $1.8 < \log P_e < 3.8$. A.Beer

523.877

5662. SMALL MOTIONS IN A GASEOUS STELLAR MASS IN ADIABATIC EVOLUTION. I. C.Agostinelli.
R.C. Accad. Naz. Lincei, Vol. 20, No. 2, 212-17 (Feb., 1956). In Italian.

A second-order differential equation is set up for the velocity at any point, stellar material being regarded as a perfect fluid. R.A.Newing

523.877

5663. OBSERVATIONS OF PULSATING STARS. I. THE SUPER-GIANT SYSTEM, BM CASSIOPEIAE. G.Thiessen.
Z. Astrophys., Vol. 39, No. 2, 65-94 (1956). In German.

In this system, the first to be discovered in which a cepheid occurs as a component — thus permitting a rigorous analysis without assuming the mass–luminosity law — the period-parameter, $Q = 0.0302$, is close to the theoretical value 0.0309, for pulsating stars of high central mass concentration (Epstein, Schwarzschild) and the cepheid has a mass smaller by a factor of about 0.25 than that predicted from the m–l relation. The observed mass of the A5 super-giant is also smaller than that obtained from the m–l law by a factor of 0.677. D.R.Barber

529.786

5664. ATOMIC AND ASTRONOMICAL TIME. L.Essen and J.V.L.Parry.
Nature (London), Vol. 177, 744-5 (April 21, 1956).

Comparison curves are given showing the frequency

deviations (in parts in 10^9) of a caesium atomic resonator time standard and quartz clocks calibrated in astronomical time. A caesium standard now being designed at the N.P.L. will give an accuracy of ±1 part in 10^{10}, and it seems clear that some atomic standard will be used in the future to make the unit of time available. G.M.Brown

PHYSICS 53

53

5665. SCIENCE AND TECHNOLOGY IN INDUSTRY. J.Cockcroft.
Brit. J. appl. Phys., Vol. 7, No. 6, 199-203 (June, 1956).
A lecture which describes some of the more important contributions of science and technology to industrial development during the last ten years. Mention is made of radar, transistors, digital computers, electronic instruments, and the nuclear power and chemical industries. A.

53

5666. THE DIFFERENTIATION OF EXPERIMENTAL LAWS. P.Vernotte.
J. Phys. Radium, Vol. 16, No. 12, 131 S - 133 S (Dec., 1955). In French.
The author's method of obtaining the derivative of experimentally determined functions is described; the errors involved are discussed. N.M.King

FUNDAMENTALS 530.1

530.1

5667. WHAT ARE VARIABLES AND CONSTANTS? K.Menger.
Science, Vol. 123, 547-8 (March 30, 1956).
See British Journal for the Philosophy of Science, Vol. 5, 134-42 (1953) and author's book "Calculus. A Modern Approach" Boston: Ginn, (1955). Clarifies the distinction between the notion of quantity as used in science and as used in logic, and mentions the confusion in the literature concerning numerical and fluent variables. A constant is a variable quantity (fluent) whose range consists of a single number. S.Weintroub

530.12

5668. RELATIVITY. THE SPECIAL THEORY. J.L.Synge. Amsterdam: North-Holland Publishing Company (1956) xiv + 450 pp.
Review in Nature (London), Vol. 177, 906-7 (May 19, 1956).

530.12 : 531.18

5669. ON TRANSFORMATIONS IN RELATIVISTIC MECHANICS. R.K.Pathria.
Amer. J. Phys., Vol. 24, No. 5, 411-13 (May, 1956).
The transformation laws previously derived for momentum and energy (Abstr. 2634/1956) are restated in terms of hyperbolic functions and their geometrical significance in Minkowski space-time is discussed. The results are generalized for a set of n inertial systems moving in one direction, the motion of the particle being no longer confined to this direction. R.A.Newing

530.12

5670. RED-SHIFT AND EQUATIONS OF MOTION. A.Papapetrou.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 214-24 (1956). In German.
The standard formula for the gravitational red-shift is derived by calculating the energy levels of a Bohr model atom in a Schwarzschild field, and also by using a Reimannian generalization of the Dirac equation for the electron. The purpose of the investigation is to base the derivation of Einstein's formula directly upon the equations of motion and therefore upon the field equations. R.A.Newing

530.12

5671. ON THE ELECTROMAGNETIC POTENTIAL CREATED BY CHARGED PARTICLES. Pham Tan Hoang.
C. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2103-6 (April 23, 1956). In French.
The Riemannian metric tensor is expanded in terms of a parameter and a 5th-order approximation is obtained for the potential due to a system of charged particles. R.A.Newing

530.12

5672. ON THE METRICAL ENERGY MOMENTUM TENSOR AND NOETHER'S THEOREM. J.Winogradzki.
Cahiers de Phys., No. 67, 1-5 (March, 1956). In French.
Field equations derived from a variational principle, the action function being invariant with respect to an n-parameter group of transformations, imply n conservation equations. Invariance with respect to the group G_6 of rotations in Minkowski space-time is used to deduce the general structure of T_{ik}; some general properties of this tensor, such as symmetry and conservation, are derived from the invariance of the action function with respect to translations and displacements. R.A.Newing

530.12

5673. INFLUENCE OF EXPANDING SPACE ON THE GRAVITATIONAL FIELDS SURROUNDING INDIVIDUAL STARS. P.C.Vaidya and K.B.Shah.
Nature (London), Vol. 177, 802 (April 28, 1956).
It is suggested that the Einstein–Strauss conclusion that expanding space has no influence on the field around a star is no longer valid if the star is regarded as a source of radiation. R.A.Newing

530.12

5674. GRAVITATIONAL MOTION AND HAMILTON'S PRINCIPLE. B.Bertotti.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 655-7 (March, 1956).
A one dimensional variational principle is introduced for a test particle moving in a gravitational field and gives the paths to be geodesics and the rest mass to be a constant of motion. The action function reduces to T - V in the weak field approximation. R.A.Newing

530.12 : 530.145

5675. THE TWO-BODY PROBLEM IN THE THEORY OF THE QUANTIZED GRAVITATIONAL FIELD. E.Corinaldesi.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 189-95 (March, 1956).
The equations of the two-body problem of general relativity are derived by a Hamiltonian method based on an expansion of the general covariant Lagrangian in powers of the gravitational constant and by employing the techniques and the viewpoint of quantum field theory. It is found that, within the approximation in which they have so far been calculated, the equations could have been obtained identically from a linear theory of gravitation. A.

530.12

5676. RIGOROUS SPHERICALLY SYMMETRIC SOLUTIONS OF EINSTEIN'S FIELD EQUATION. K.Just.
Z. Phys., Vol. 145, No. 2, 235-40 (1956). In German.

The field equations of general relativity with zero cosmological constant are used to obtain a metric for a fluid at rest in the coordinate system, pressure being negligible in comparison with density. By introducing the requirement that the limiting form as $t \to \infty$ is homogeneous with Euclidean 3-space, the metric is reduced to the form

$$ds^2 = e^{\omega}\{(\tfrac{1}{3}\frac{\partial\omega}{\partial r}dr)^2 + d\theta^2 + \sin^2\theta\, d\phi^2\} - dt^2,$$

where $e^{\omega} = r^2(t-b)^{4/3}$ and b is an arbitrary function of r subject to the condition $b \to 0$ as $r \to \infty$. The density is found to be $(4/3\kappa)\{(t-b)[t-b-(2r/3)db/dr]\}^{-1}$. R.A.Newing

530.145 : 530.12

5677. ON THE DETERMINATION OF THE EQUATIONS OF MOTION FROM A GENERAL, COVARIANT, NON-LINEAR FIELD THEORY BY THE APPROXIMATION METHOD OF EINSTEIN, INFELD, AND HOFFMAN. R.H.Penfield and H.Zatzkis.
Acta phys. Austriaca, Vol. 10, No. 1-2, 87-94 (1956).

530.145

5678. NON-LINEAR FIELD THEORY. K.Bechert.
Z. Naturforsch., Vol. 11a, No. 3, 177-82 (1956). In German.

The theory developed in previous papers is put into general covariant form. The results include possible deviations from Einstein's gravitational equations in empty space and from the Lorentz equation of motion. A solution corresponding to a point particle of finite mass and charge at rest is found to lead to an infinite field energy. W.A.Hepner

530.145

5679. REGULARIZED THEORY OF SYSTEMS OF FIELDS. É.M.Lipmanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 214-16 (1956). In Russian.

Since regularization amounts to a transition from the usual theory to a theory with higher derivatives, a typical equation with higher derivatives is studied here. A way to avoid the negative energies usually arising in such a theory is outlined. G.E.Brown

530.145

5680. RELATIVISTIC EFFECTS OF REPULSION IN A SCALAR FIELD AND OF ATTRACTION IN VECTOR FIELD. Ya.P.Terletskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 419-20 (1956). In Russian.

The demonstration that an attractive potential in a relativistic equation leads to some repulsive or attractive terms in the scalar and vector theories, respectively, in the equivalent non-relativistic equation, is made directly, without first reducing the relativistic equation to its non-relativistic approximations. G.E.Brown

530.145

5681. RAĬSKIĬ'S (RAYSKI'S) THEORY OF BILOCAL FIELDS. V.A.Zhirnov.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 425-6 (1956). In Russian.

Rayski's new formulation (Abstr. 9407, 9423/1955) leads to negative masses and signals travelling faster than light. G.E.Brown

530.145

5682. ON THE USUAL REPRESENTATION OF THE COMMUTATION RULES IN QUANTUM FIELD THEORY. D.Kastler.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1132-4 (Feb. 27, 1956). In French.

Bose or Fermi particle field space is described as the sum of the symmetric or antisymmetric sub-spaces of the tensor forces of the space describing a single particle. Creation and annihilation operators are related to the external (symmetric) product of the corresponding state vector. N.M.King

530.145

5683. ON THE QUANTIZED FIELDS OF PARTICLES OF ARBITRARY SPIN. COMMUTATION RELATIONS. R.Potier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1694-7 (March 26, 1956). In French.

An application of the author's general method (Abstr. 347[illegible] 4808/1956). P.T.Matthews

530.145

5684. ON THE GENERAL THEORY OF QUANTIZED FIELDS: OPERATORS, EQUATION OF EVOLUTION, SCHRÖDINGER REPRESENTATION. R.Potier.
C. R. Acad. Sci. (Paris), Vol. 242, No. 16, 1961-4 (April 16, 1956). In French.

The author introduces infinitesmal transformations which lead to a Hamiltonian relation not involving the zero-point energy, thus avoiding the non-convergent tensor traces. The result is not dependent on the use of orthonormal wave functions. N.M.Kin

530.145

5685. FERMION FIELDS AND FEYNMAN'S METHOD OF QUANTIZATION. P.Bocchieri, A.Loinger and G.M.Prosperi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 832-4 (April, 1956). In Italian.

It is concluded that Feynman's method of field quantizatio is essentially restricted to boson variables. J.M.Radcliffe

530.145

5686. ON MULTIPLE PHOTON PRODUCTION. G.Eder.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 885-92 (May, 1956). In German.

The average number of bremsstrahlung photons, for high-energy electrons or vector mesons, is examined by perturbation theory. For low-energy photons, the average number increases logarithmically with the primary energy and with the maximum photon energy. For high-energy photons the number for vector mesons, increases quadratically with the maximum photon energy. P.T.Matthews

530.145

5687. ON THE LIMIT OF APPLICABILITY OF QUANTUM ELECTRODYNAMICS. S.Kamefuchi and H.Umezawa.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1060-8 (May, 1956).

The general features of the Z_3-factor or those of the normal zone of the renormalized charge in quantum electrodynamics are discussed in detail by use of the method of renormalization cut-off developed previously (Abstr. 4814/1956). It found that the renormalization theory of quantum electrodynamics is consistent only when one introduces the cut-off momentum Λ which is smaller than $\lambda = m \exp[3\pi \cdot 137/2]$. The peculiar features are also discussed which appear in connection with the state of negative norm unless a suitable cut-off factor is introduced. A.

530.145

5688. CLASSICAL MAXWELL THEORY WITH FINITE-PARTICLE SOURCES. R.Ingraham.
Phys. Rev., Vol. 101, No. 4, 1411-19 (Feb. 15, 1956).

A Lorentz-invariant finite-particle model is introduced into the Maxwell theory by extending the space from space-time to all (timelike) space-time spheres. The properties of the model are examined in the classical theory as a preliminary to the quantized case. The space-time sphere radius λ is the parameter of finiteness; it has the effect of smearing point particles into bell-shaped bounded distributions which go over into the δ-function point-particle distributions in the limit $\lambda = 0$. The smeared particles give rise to fields in which the Coloumb infinity no longer exists. It is shown that the finite-particle 4-current has various indispensable formal properties: that charge is conserved; and that, in interaction with its field, momentum and energy are conserved, the integrals representing the electromagnetic self-energy and self-force

ing convergent for $\lambda \neq 0$. This replacement of point by nite particles results in corrections to calculations which re probably negligible where the classical theory is valid, t which might be appreciable in the quantum domain at dis- nces comparable to λ. A.

530.145 : 537.11

389. A UNIFIED INTERPRETATION OF LIGHT AND ATTER. W.Glaser.
B. Osterr. Akad. Wiss. IIa, Vol. 163, No. 8-10, 215-65 954). In German.

A model for elementary particles is proposed in which a hoton is constrained to move in a confined region R of space. is shown that the region R moves as a material particle sub- ct to the laws of relativistic mechanics. Equivalent results re obtained for the motion of a wave packet. Maxwell's quations, solved subject to the condition of no energy flow ver the boundary of R, give a spectrum of particle radii, an ffective mass and a total angular momentum that can be iden- fied with observed spin. A new derivation of the electromag- etic equations is based on considerations of energy and mo- entum, and these equations are generalized to give Klein— ordon type equations for matter (see also Abstr. 1544/1955), ue dimensions of the region R being given by l/k. A system f linear field equations is set up and the classical theory of he point electron is shown to follow as a limiting case. An xtension of the theory to include the Dirac equation for the lectron is also considered. R.A.Newing

530.145

390. MESON—MESON INTERACTION FROM A FIELD-HEORETICAL-MODEL. B.Bosco and R.Stroffolini.
uovo Cimento (Ser. 10), Vol. 3, No. 3, 662-4 (March, 1956).

The meson—meson interaction is studied in a field theore- c model of the Lee type, which can be solved exactly. P.T.Matthews

530.145

391. ON THE MEANING OF FERMI COUPLING. B.Jouvet.
uovo Cimento (Ser. 10), Vol. 3, No. 5, 1133-5 (May, 1956).

A Fermi type interaction may be renormalized if it is garded as a Yukawa interaction, in the limit of the meson ass tending to infinity. The treatment yields two relations, hich may determine the observable parameters. P.T.Matthews

530.145

392. THE RELATIVISTIC FLUID MODEL DESCRIBING IE WAVES OF A PARTICLE OF SPIN ZERO. F.Halbwachs.
R. Acad. Sci. (Paris), Vol. 242, No. 13, 1689-91 (March 26, 56). In French.

The energy—momentum tensor for a particle satisfying e Klein—Gordon equation is decomposed to exhibit the new drodynamic variables. P.T.Matthews

530.145

393. RELATIVISTIC FLUID MODEL DESCRIBING EMMER WAVES FOR THE CORPUSCLE OF SPIN 0. .Halbwachs.
. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2106-9 (April 23, 956). In French.

The fluid model derived from the Lagrangian of Kemmer's inor representation is found to differ from that derived from e Klein—Gordon equation. R.A.Newing

530.145

394. REPRESENTATION OF CHARGE CONJUGATION FOR RAC FIELDS. B.P.Nigam and L.L.Foldy.
ys. Rev., Vol. 102, No. 5, 1410-12 (June 1, 1956).

Explicit representations of the charge conjugation trans- rmation for fermion fields are derived in a form which does t make explicit reference to the expansion of the fields in a mplete orthonormal set of space and spin functions. It is own that the different forms must be equivalent if one is working in an irreducible representation of the Wigner—Jordan anticommutation rules, but it has not been found possible to prove the equivalence directly, thus suggesting that the representations are not equivalent if the representation of the anticommutation relations is not irreducible. The results are applied to the clarification of an apparent paradox concerning commutability of the charge conjugation and space inversion transformations. A.

530.145

5695. SYMMETRIES IN ISOTOPIC SPIN SPACE AND THE CHARGE OPERATOR. B.d'Espagnat and J.Prentki.
Phys. Rev., Vol. 102, No. 6, 1684-5 (June 15, 1956).

A general relation is shown to exist between the charge and the operator inducing a symmetry with respect to the 1,2 plane in isotopic spin space. This relation is unique, i.e., it is the same for all types of fields (baryons and mesons). A.

530.145

5696. ON THE DEFINITION OF SPIN DIRECTION IN THE DIRAC THEORY. H.Koppe.
Z. Phys., Vol. 145, No. 3, 398-402 (1956). In German.

The general form is discussed of an operator Σ that shall be a constant of motion representing spin about the direction of an arbitrary unit vector $\vec{s}$, reducing to the operator $\vec{s}.\vec{\sigma}$ in the non-relativistic case. The operators introduced by Foldy—Woythusen (1950) and by Stech (Abstr. 2671-2/1956) are included as special cases. It is shown that under certain conditions the Stech operator may be regarded as the most suitable one. R.A.Newing

530.145

5697. ON THE INTEGRAL EQUATION FOR THE HEISENBERG CURRENT OPERATOR. J.C.Polkinghorne.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 658-60 (March, 1956).

A relation employed by Cini and Fubini (Abstr. 4184/1956) to derive a non-linear equation for the Heisenberg current operator, is shown to be closely connected to the necessary and sufficient condition that the meson field variables satisfy canonical commutation relations on any space like surface. P.T.Matthews

530.145

5698. EXPANSION OF WAVE FUNCTIONS IN IRREDUCIBLE REPRESENTATIONS OF THE LORENTZ GROUP. I.S.Shapiro.
Dokl. Akad. Nauk. SSSR, Vol. 106, No. 4, 647-9 (1956). In Russian.

Single-particle wave functions (in 4-momentum space, without spin) will, under the effect of a Lorentz transformation, transform by linear combination. This linear combination can be obtained in the form of a functional of a type not unlike the Mellin transformation. The corresponding "Mellin transforms" are identified as the basic vector systems of irreducible representation matrices of the Lorentz group. R.Eisenschitz

530.145

5699. NOTE ON THE INITIAL VALUE PROBLEM FOR THE WAVE EQUATION IN N DIMENSIONS. J.R.Pounder and J.L.Synge.
Proc. Roy. Irish Acad. A, Vol. 57, No. 9, 151-9 (Nov., 1955).

The solution of the initial value problem is based on a complex wave function without singularities. This is a generalization to N dimensions of a function which can be used to generate Maxwell fields free from singularities (J.L.Synge, Proceedings of the International Congress of Mathematicians, Vol. 2, 380-1, 1954), and it is closely related to the function used to solve the inhomogeneous wave equation by a Fourier integral method (L.Gårding, Acta Mathematica, Vol. 85, 1-62, 1950). W.A.Hepner

530.145

5700. THE UNCERTAINTY RELATION FOR THE DIRAC EQUATIONS AND FOR THE RELATIVISTIC SCHRÖDINGER EQUATION. H.Harmuth.

Z. Naturforsch., Vol. 11a, No. 2, 101-18 (1956). In German.

The time-dependent Schrödinger equation for the one-dimensional motion of a free particle is replaced by a difference equation and the condition for the convergence of solutions of this equation is obtained in the form $m(\Delta x)^2 \geq 2\hbar\Delta t$. A discussion of physical measuring processes is used to show that the inequality can be interpreted physically as $\Delta x\Delta p \geq 2\hbar$, $\Delta E\Delta t \geq \hbar$. A corresponding discussion of the relativistic equation gives the convergence condition

$$4c^2(\Delta t)^2[1 + (\Delta x)^2/4\lambda^2)] \leq (\Delta x)^2,$$

with $\lambda = \hbar/m_0c$, from which are derived the generalized relations $\Delta x\Delta p \geq 4A\hbar m/m_0$, $\Delta E\Delta t \geq 2A\hbar m/m_0$ where A can be $[1 + (2\lambda/\Delta x)^2]^{-1/2}$ or $[1 + (\lambda/c\Delta t)^2]^{-1/2}$. Corresponding relations are derived for the linear Dirac equations in the case of three-dimensional motion, and motion in a potential field is also considered. If Δx and $c\Delta t$ are both much greater than λ, the generalized relations reduce to Heisenberg's, apart from a factor 2, in the case of negligible relativistic mass increase. The factor 2 is associated with the two mass states of the relativistic equations. R.A.Newing

530.145

5701. CORRESPONDENCE BETWEEN THE KEPLER PROBLEM OF CLASSICAL MECHANICS AND THE SCHRÖDINGER EIGENFUNCTIONS OF THE HYDROGEN ATOM. R.Hosemann and S.N.Bagchi.
Z. Phys., Vol. 145, No. 1, 65-82 (1956). In German.

The non-relativistic Kepler problem is discussed in terms of two guiding waves ϵ_1 and ϵ_2 whose phases are solutions of the Hamilton–Jacobi equation. It is shown that for large quantum numbers ϵ_1 and ϵ_2 are solutions of the Schrödinger wave equation which cannot be regarded as wavefunctions on account of the occurrence of branch points. The wavefunctions Ψ are identified with the sum $\epsilon_1 + \epsilon_2$ but the physical significance of $\Psi\Psi^*$ is questioned. It is suggested that ϵ_1, ϵ_2 rather than Ψ, are of fundamental importance in microphysics. R.A.Newing

530.145

5702. ASYMPTOTIC THEORY OF THE SCATTERING OF MESONS BY MESONS. I.T.Dyatlov and K.A.Ter-Martirosyan. Zh. éksper. teor. Fiz., Vol. 30, No. 2, 416-19 (1956). In Russian.

Graphs having closed nucleon boxes (four nucleon lines) are summed. G.E.Brown

530.162

5703. THE MATHEMATICS OF DIFFUSION. J.Crank. London: Oxford University Press (1956) 356 pp.

"This book is written for those who are interested in the mathematical work which has been done in diffusion within the last ten years, and who wish to have the results of this and earlier work presented in a readily usable form".

530.162 : 539.11

5704. AN APPROXIMATION METHOD FOR ORDER-DISORDER PROBLEMS. IV. J.Hijmans and J.de Boer. Physica, Vol. 22, No. 5, 408-28 (May, 1956).

The approximate expression for the free energy of an order-disorder system (a ferromagnet in the Ising model, or a lattice gas), and the equilibrium and consistency equations, which have been obtained in Pt I-III (Abstr. 7715-17/1955), are derived by an entirely different method. This method is based on a set of equations, given by J.E.Mayer (Abstr. 9391/1955), which express the grand partition function and the distribution functions for the system in a state of fugacity y, in terms of the same functions for the system at fugacity z. The special case, y = 0, of these relations yields a set of equations, expressing the partition function and the known Boltzmann-factors in terms of the unknown distribution functions. Both members of these implicit equations are written in the form of a series of rapidly decreasing terms. By taking into account in these series only terms up to a given order of magnitude, a set of approximate equations is derived, from which approximate expressions for the partition function and the distributio functions can be obtained. The first approximation yields the results of the Bethe, or quasi-chemical method. The method discussed in the previous papers is included as a special case in the present method. A

530.162 : 539.1

5705. AN APPROXIMATION METHOD FOR ORDER-DISORDER PROBLEMS. V. J.Hijmans.
Physica, Vol. 22, No. 5, 429-42 (May, 1956).

The significance of the approximations is discussed in more detail on the bases of the model of a lattice gas. The contributions to the probabilities, introduced previously, can be interpreted as sums over so-called U-functions, which for a lattice gas have a meaning similar to the U-functions introduced by Mayer for a continuous system. The expression in terms of U-functions makes it possible to draw conclusions a to the order of magnitude of the probability contributions, thu justifying the approximation procedure used previously. A

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.224.4

5706. FINDING THE BUCKLING OF AN ELLIPTIC CYLINDER. P.F.Gast and A.Bournia.
Nucleonics, Vol. 14, No. 4, 109-13 (April, 1956).

Solutions of the equation $\nabla^2\phi + B^2\phi = 0$ which are of interest for reactors of right elliptic cylindrical shape are discussed. Tables are given enabling B^2 to be calculated for values of c (the ratio of semi-axes) from 1 to 6. An approximate value for the buckling of an ellipse can be obtained by multiplying the buckling of a circle or radius equal to the semi minor axis of the ellipse by $(1 + c^3)/2c^2$. The error in this approximation is $<1\frac{1}{2}\%$ for $C \leq 2$. R.D.Smith

531.224.7

5707. FLEXURE OF THIN ELASTIC PLATES UNDER SPECIFIED EDGE TRACTIONS. V.Cadambe, R.K.Kaul and S.G.Tewari.
Indian J. Phys., Vol. 29, No. 9, 403-16 (Sept., 1955).

The solution of the deflection surface of an isotropic bent plate characterized by fourth-order Lagrange's differential equation is a difficult problem, especially if the boundary conditions contain higher-order partial differential relations. To make it simpler, this problem is replaced by two second-orde simultaneous differential equations in U and V defining the bending and twisting moments in the plate. For problems where boundary tractions are known, it becomes more convenient to work in terms of U and V, since the partial differential relations between the derivatives in w are replaced by known values of these new functions at the free edges and linear combinations of their first order derivatives at the clamped edges. In addition, the relaxation method when applied to the simultaneous equations so obtained leads to rapid convergence unlike in the case of the bi-harmonic equation. The Southwell differential equations and the boundary conditions are, therefore, derived by variational principles and to illustrate the definite advantage of the process, two typical examples are also worked. A.

531.51

5708. ON A NEW THEORY OF GRAVITATION. Q.Majorana R.C. Accad. Naz. Lincei, Vol. 19, No. 3-4, 95-101 (Sept.-Oct., 1955). In Italian.

An attempt is made to sketch a classical theory based on the emission and absorption of gravitons. R.A.Newing

531.552 : 536.421.1

5709. ABLATION FROM ALUMINUM ULTRASPEED PELLETS. W.C.White.
Astrophys. J., Vol. 122, No. 3, 559-64 (Nov., 1955).

Velocities of droplets ablated from the surface of ultraspeed pellets have been obtained experimentally. The velocity data were analysed to obtain the initial radii and masses of the droplets, which were 5-100 μ and 0.002-12.5 μ g, respectively. An average mass of the droplets was used to obtain the amount of material ablated in a given distance along the trajectory. The amount of mass ablated by melting was found to depend linearly on the distance the pellet has moved along its trajectory. A.

MECHANICAL MEASUREMENTS 531.7

531.752

5710. INCREASE OF SENSITIVITY AND RELATIVE ACCURACY OF THE ELECTRIC MICROBALANCE. T.Gast.
Z. angew. Phys., Vol. 8, No. 4, 164-71 (1956). In German.

An improved model of the automatic recording balance of R.Vieweg and T.Gast (Kunststoffe, Vol. 34, 117, 1944) is described. The quartz balance beam is attached to a ring-shaped coil which is suspended horizontally on a torsion head. The coil moves in a magnetic field and the induced current in the coil is amplified, rectified and fed back as a resulting force to maintain the balance in the rest position and to operate a recorder recording the change in weight against time. The induced signal is proportional to the angle of rotation. The amplifier circuit is described in some detail and the various instrumental, circuital and mechanical sources of error are discussed. The equation of motion of the system is considered and suitable values of the various components in order to obtain the desired sensitivity are evaluated. A zero-point constancy of 0.1 microgram over several hours and a sensitivity of the order of 1 scale-division per microgram with an accuracy of about 1% are obtainable. S.Weintroub

531.787.1

5711. AN ELASTIC MANOMETER IN THE FORM OF A STRAIGHT CYLINDER WITH ECCENTRIC BORE FOR PRESSURES UP TO 9500 kg/cm^2. J.Gielessen.
Z. angew. Phys., Vol. 8, No. 4, 193-5 (1956). In German.

The construction and performance are described. An internal pressure causes the cylinder to bend towards the thicker wall, the displacement being measured with a dial gauge. Deflection is proportional to pressure (measured with a manganin resistance gauge) to better than 1% and in good agreement with Wuest's theory. [Ingenieur-Archiv, Vol. 19, 2 (1951)]. F.Ansbacher

MECHANICS OF FLUIDS 532

532.13

5712. TEMPERATURE DEPENDENCE OF THE VISCOSITY OF LIQUIDS. E.J.Hellund.
J. chem. Phys., Vol. 24, No. 6, 1173-4 (June, 1956).

The consequences of the introduction of long-range disorder into the theory of the liquid state are examined. Application is made to the analysis of viscosity. A.

532.13 : 533.16

5713. ON A VISCOSIMETRIC METHOD FOR THE FORMATION OF THE PRODUCTS OF TWO MEASURED VALUES WITH PROGRESSIVE TIME SUMMATION. A.Wesp.
Z. angew. Phys., Vol. 8, No. 4, 158-64 (1956). In German.

Using paddle viscosmeters and venturi flowmeters, methods are described for integration of viscosities, temperatures and flows of gases and liquids. T.C.Toye

532.14

5714. MAXIMUM OF THE DENSITY RATIO OF HEAVY TO LIGHT WATER. V.Grossmann-Doerth.
Z. Naturforsch., Vol. 11a, No. 3, 254-5 (1956). In Ger, an

In the author's previous measurements (Abstr. 952/1956) the density ratio was a maximum at 100°C approx., whereas the results of other investigators indicate 110°C approx. Additional measurements were therefore made over the range 60 to 100°C and the results are now reported. Good agreement is obtained up to 80°C only and it is concluded that the methods used by the other investigators were not sufficiently accurate near to 100°C. S.Weintroub

532.51 : 621.68 : 621.313

5715. THEORY OF THE IDEAL A.C. CONDUCTION PUMP. W.Murgatroyd.
Atomic Energy Res. Establ. (Harwell) Rep., No. ED/R 1566, 9 pp. (1956),

Equations are presented giving the pressure rise, ohmic loss, and impedances of an ideal a.c. conduction pump. An ideal pump is one in which there are no end, tube, or friction losses. Curves are included to facilitate calculations of the relevant quantities. In an appendix the operation of a pump with compensating windings is analysed. It is shown that there is an optimum length for this type of pump, and a corresponding minimum ohmic loss, which is dependent only upon the pressure rise, maximum field strength, frequency, and fluid properties. A table is included giving this loss under various practical conditions. A.

532.517

5716. ON THE VISCOUS SHEAR FLOW AROUND A CIRCULAR CYLINDER. II. OSEEN'S APPROXIMATION. M.Kawaguti.
J. Phys. Soc. Japan, Vol. 11, No. 5, 570-83 (May, 1956).

For previous work see Report of the Institute of Science and Technology, Tokyo, Vol. 6, 85 (1952). The shear flow of a viscous fluid around a circular cylinder has been studied to Oseen's approximation and has been compared with the author's previous results for Stokes' approximation. The formulae for the drag and the lift have been obtained neglecting the terms of orders O(Re), O(αRe^{-1}), O(α^2), and it has been shown that the drag is not affected by the presence of the shear, and that the direction of the lift is the same as that for inviscid shear flow within the order of the approximation. A.

532.517

5717. NOTE ON RAYLEIGH'S PROBLEM FOR A CIRCULAR CYLINDER WITH UNIFORM SUCTION AND RELATED UNSTEADY FLOW PROBLEM. H.Hasimoto.
J. Phys. Soc. Japan, Vol. 11, No. 5, 611 (May); Erratum, No. 6, 721 (June, 1956).

Recently, Stewartson et al (1955) have shown the utility of Rayleigh's problem relating to the boundary layer associated with flow past a long circular cylinder. In continuation of previous work (Abstr. 3346/1952, 9962/1954, 5908/1955), the author obtains the solution of this flow problem for the case of uniform suction, and the related unsteady flow problem. The solutions show clearly the effect of suction on the growth of the boundary layer, and contrast with the solution for a flat plate. J.S.G.Thomas

532.584 : 533.6.011.31

5718. IMPINGEMENT OF PARTICLES ON A TRANSVERSE CYLINDER. C.N.Davies and C.V.Peetz.
Proc. Roy. Soc. A, Vol. 234, 269-95 (Feb. 7, 1956).

When a suspension of particles in a fluid sweeps past a cylindrical rod transverse to the flow, some particles are deposited but others are carried sideways by the fluid as it divides to pass the rod. The phenomenon has been suggested as a basis for the determination of sizes of mist droplets and hoar frost particles and to estimate loss of insecticide aerosols amongst trees. In this paper a large number of particle trajectories are computed (See also Abstr. 799/1952) for solid

particles of a range of sizes and for three flow regions: (i) ideal fluid, for which the flow field is easily calculated by potential theory, (ii) transition type of flow, sufficiently rapid for the inertia of the fluid to have modified the viscous pattern but too slow for pronounced turbulence downstream or for a boundary layer on the leading surface, (iii) viscous flow at a low Reynolds number. The results are compared with those of other workers. S.J.Gregg

MOLECULAR THEORY OF LIQUIDS 532.7

532.72

5719. SELF DIFFUSION IN MOLTEN INDIUM. A.Lodding.
Z. Naturforsch., Vol. 11a, No. 3, 200-3 (1956). In German.

Measurements in the temperature range 170 to 750° C made by a capillary method yield for the diffusion coefficient D the expression $D = 28.9 \times 10^{-5} \exp(-2430/RT)$. C.A.Hogarth

532.74 : 537.226.33 : 539.152.2

5720. NUCLEAR RELAXATION AND MOLECULAR ASSOCIATION IN LIQUIDS. L.Giulotto, G.Lanzi and L.Tosca.
J. chem. Phys., Vol. 24, No. 3, 632-3 (March, 1956).

The mean thermal angular velocity of molecules in a liquid influences the relaxation times for dielectric losses and for nuclear magnetic resonance. The former relaxation time decreases, the latter increases if the angular velocity is increased. Rotational contributions to the nuclear relaxation times are supposed to be inversely proportional to the dielectric relaxation times. For the purpose of an experimental test, experimental relaxation times are obtained for mixtures of carbon tetrachloride with phenyl chloride and with phenol. Part of the necessary measurements is made by the authors. The two relaxation times are plotted against the concentration. For phenyl chloride the authors claim to find the inverse proportionality, as required by theory; in doing so, it is, however, necessary to make a substantial, if plausible, allowance for translational contributions to nuclear relaxation times. Results obtained with phenol do not admit any simple interpretation; the authors regard the results as evidence for cluster formation. R.Eisenschitz

532.77 : 541.64 : 532.13

5721. VARIATION OF VISCOSITY OF COILING POLYMERS WITH SHEAR RATE. F.Bueche, J.K.Wood and J.R.Wray.
J. chem. Phys., Vol. 24, No. 4, 903 (April, 1956).

An improved equation (containing no unknown parameters) expressing the non-Newtonian flow behaviour of coiling polymer molecules is found to give fair agreement with the experimental viscosity data for solutions in which very few entanglements exist per molecule, but not with data for solutions in which five or more entanglements exist per molecule. W.Good

MECHANICS OF GASES 533

533.15

5722. EVALUATION OF COLLISION INTEGRALS OCCURRING IN HIGHER APPROXIMATIONS TO DIFFUSION COEFFICIENTS. S.C.Saxena.
J. chem. Phys., Vol. 24, No. 6, 1209-10 (June, 1956).

Several Chapman and Cowling collision integrals for the Lennard-Jones 12 : 6 model have been evaluated over an extensive range of temperatures and utilized to calculate the second approximation to the thermal diffusion ratio for the case of argon–helium gas pair. A.

533.1

5723. GENERALISED RELATIONS FOR THE THERMAL DIFFUSION FACTOR OF INERT GAS MIXTURES WITH ONE INVARIABLE CONSTITUENT. B.N.Srivastava and S.C.Saxer
Physica, Vol. 22, No. 4, 253-62 (April, 1956).

The variation of the thermal diffusion factor α for binary mixtures of inert gases, when one constituent is kept fixed and the other varied, has been investigated and semi-empiric formulae have been derived for the variation of α with the proportionate mass difference of the molecules. These resul are explained in terms of the Chapman–Enskog formula for the case of Lennard-Jones 12 : 6 model by utilizing the exper mentally obtained unique dependence of the force constants ϵ_{ij} and ν_{ij} on the molecular mass of the variable constituent for a given series of mixtures. The same considerations are applied to isotopes of monatomic molecules and suitable formulae are deduced for α, ϵ_{11} and ν_{11}. The formulae are tested by calculating the force constants of radon. A.

533.5

5724. A THERMOELECTRIC VACUUM GAUGE. H.Schlitt
Z. angew. Phys., Vol. 8, No. 5, 216-17 (1956). In German.

Range 10^{-2} to 1 mm Hg. The construction is described ar a calibration curve, alongside that of a Pirani gauge, is giver The cold junction is in good thermal contact with the glass envelope of the gauge and the hot junction lies inside a heating coil wound on a glass capillary tube. The e.m.f. is approximately 1 mV at atmospheric pressure and 12 mV in vacuo for a heating current of 5 mA. S.Weintroub

533.5

5725. ON A POSSIBLE SOURCE OF ERROR IN PRESSURE MEASUREMENT WITH A CAPACITY-MICROMANOMETER. G.Milazzo.
Z. Elektrochem., Vol. 60, No. 2, 185-8 (1956). In German.

The construction, method of operation and three ways of using a metal diaphragm micromanometer for the measurement of pressures of $1\text{-}10^{-3}$ mm Hg are described. The presence of adsorbed vapours of substances with considerable dipole moments may introduce an error of several per cent and this is illustrated by a particular numerical example. By suitable arrangements the error can be avoided. S.Weintroul

533.5 : 531.784 : 531.714

ELECTRONIC INDICATORS OF MECHANICAL QUANTITIES. See Abstr. 4857

533.6.011 : 536.468

SPARK IGNITION OF FLOWING GASES. See Abstr. 5048

MOLECULAR THEORY OF GASES 533.7

533.7 : 533.16

5726. THE TRANSPORT PROPERTIES AND THE EQUATION OF STATE OF GASEOUS PARA- AND ORTHO-HYDROGEN AND THEIR MIXTURES BELOW 40° K. E.G.D.Cohen, M.J.Offerhaus, J.M.J. van Leeuwen, B.W.Roos and J.de Boer.
Physica, Vol. 21, No. 9, 737-9 (Sept., 1955).

Hydrogen molecules are assumed to interact with central forces as derived from a 6-12-potential. From the field of force the quantum-mechanical collision cross-sections and, hence, the viscosity and the second virial coefficients are calculated. There are deviations from the classical law of corresponding states which are due to diffraction and correlation effects. The former are equal for the two modifications of hydrogen and numerically smaller than for helium. The calculated quantities are in fair agreement with observation. R.Eisenschitz

VIBRATIONS. ACOUSTICS 534

534.113

5727. EFFECT OF A CONCENTRATED MASS ON THE CHARACTERISTIC MODES OF VIBRATION OF A BEAM RESTING ON AN ELASTIC SUPPORT. Y.Jullien.
J. Phys. Radium, Vol. 16, No. 12, 107 S - 108 S (Dec., 1955). In French.

Suitable equations are developed and confirmed by experiment. W.Bardsley

534.213 : 532.51

5728. ROTATIONAL FLOW OF A VISCOUS LIQUID. T.Olsen.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 313-14 (March, 1956).

Skavlem and Fjötta's (Abstr. 2503/1955) theory has been checked for a brass rod mounted coaxially in a Plexiglass tube filled with air. Good agreement is found. T.C.Toye

534.22/.23 : 532.7

5729. SOUND PROPAGATION IN LIQUIDS. S.Parthasarathy and M.Pancholy.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 417-22 (1956).

Recent work in the field of ultrasonic velocity and absorption in liquids is critically examined in relation to other physical properties of the media. Considerations of sound propagation suggest for the liquids a structure quite distinct from that of solids or gases. A.

534.22

5730. THEORY OF THE VELOCITY OF SOUND IN METALS. K.H.Schramm.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5. 242-8 (1956). In German.

A relation is derived between the velocity of propagation of small disturbances in the system of conduction electrons in a metal, on the one hand, and in the system of lattice ions on the other hand. The following expression is obtained for the velocity of sound c,

$$c = h\left(\frac{3\rho}{8\pi}\right)^{\frac{1}{3}}\left(\frac{1-2\mu}{3m}\right)^{\frac{1}{2}}\left(\frac{Lf}{A}\right)^{\frac{5}{6}}$$

where h is Planck's constant, m the electron mass, L Loschmidt's number, A the atomic weight, ρ the density, f the number of conduction electrons per atom and μ Poisson's ratio. This formula, which does not contain the elastic moduli, is compared with experiment. M.R.Hopkins

534.222.2

5731. STRUCTURE OF SHOCK WAVES IN POLYATOMIC GASES. W.Griffith, D.Brickl and V.Blackman.
Phys. Rev., Vol. 102, No. 5, 1209-16 (June 1, 1956).

Describes the results of experiments using a shock tube and interferometer to study the role of vibrational relaxation in shock structure. Shocks of Mach number up to 5 have been observed in air, A, N_2, CH_4, CO_2, N_2O and CCl_2F_2. In air and nitrogen below about $M_1 = 2$ and in argon the validity of the Rankine–Hugoniot relation using constant specific heat has been established within experimental accuracy. Above $M_1 = 2$ in both air and N_2, the observed density corresponds to only partial equilibrium, no appreciable excitation of vibrational modes occurring, for example, for at least 150 μsec at 900°K. Both CH_4 and CCl_2F_2 show fast adjustment with relaxation times less than 1 μsec to the expected final state. In CO_2 and N_2O, vibrational relaxation times are observed to be in reasonable agreement with published data. The downstream state, however, is at a lower density than required for complete equilibrium and the possibility of separate relaxation times for each vibrational mode is suggested; the valence vibrations adjust at least 100 times more slowly than do the bending modes. Added traces of water vapour reduce the visible adjustment greatly but leave the final state unaltered. The catalytic effect of water vapour in speeding equilibration seems therefore to be limited to the bending modes. A.

534.23

5732. MEASUREMENTS ON ACOUSTICAL STRUCTURES WHICH ABSORB BY RESONANCE. E.Brosio.
Alta Frequenza, Vol. 25, No. 1, 32-7 (Feb., 1956). In Italian.

Measurements of the resonance frequencies and absorption coefficient of membranes of plastic materials. L.Pincherle

534.23

5733. NOTE ON THE PAPER BY C.L.DARNER AND R.J.BOBBER ON THE ULTRASONIC SHUTTER. W.G.Cady.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 312 (March, 1956).

See Abstr. 9495 (1955). The ratio of resonant frequencies for a polarized barium titanate crystal on open and on short circuit as found by Darner and Bobber is found to agree with the ratio derived from the stiffness coefficients as would be expected. It is pointed out however that zero transmission on open circuit does not necessitate the assumption that the plate has become infinitely stiff. T.C.Toye

534.23

5734. METHODS OF MEASURING SOUND ABSORPTION BY MEANS OF THE STANDING WAVES. J.Tichý.
Slaboproudý Obzor, Vol. 17, No. 4, 197-202 (1956). In Czech.

A sound waveguide is employed in the measurements. A sample is situated at the far end of the waveguide and the input of the guide is excited by an acoustic source in such a manner that plane waves, perpendicular to the axis of the device, are produced. The acoustic impedance of the sample is expressed as a function of its reflection coefficient and the constants of the system. The absorption coefficient of the sample is given as a function of pressures between two adjacent extremes (a maximum and a minimum) in the waveguide. The experimental measurement system employs a cylindrical waveguide having a diameter D such that $\lambda \geq 1.7D$, where λ is the shortest measured wavelength. The device is excited by means of a loudspeaker-driven rubber tube and the pressure is measured by a moving pick-up tube. Experimentally determined absorption coefficients of several materials are plotted over frequencies of 100 c/s to 5 kc/s. R.S.Sidorowicz

534.232

5735. THE DETERMINATION OF THE AMPLITUDE DISTRIBUTION OVER PLANE SURFACES FROM THE DIRECTIONAL PATTERN OF THEIR RADIATION FIELDS. K.Fehér.
Arch. elekt. Ubertragung, Vol. 10, No. 3, 125-31 (March); No. 4, 163-73 (April, 1956). In German.

The magnitude and phase of the amplitude distribution of an oscillating surface is linked with its far-field directional radiation pattern by a Fourier integral. If one of these two quantities is known, the other can be determined from it. This paper contains firstly the theoretical foundations of a determination of the amplitude distribution by a Fourier analysis of its directional radiation pattern, secondly a description of an experimental method, and thirdly a means of checking the method of measurement with the aid of oscillating plane plates and electrostatically excited diaphragms. The method has applications in ultrasonics where a direct measurement of the amplitude distribution with a detector for solid-borne sound meets with great difficulties. A.

534.232

5736. ON THE DISTINCTION BETWEEN VELOCITY-SENSITIVE AND PRESSURE GRADIENT-SENSITIVE MICROPHONES. T.J.Schultz.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 498 (May, 1956).

An attempt is made to formulate a distinction between velocity-sensitive and pressure-gradient-sensitive devices. It could be argued that even if one had a direct means of observing the particle velocity in the medium this too, must ultimately depend on the pressure gradient since it is that which finally moves the individual volume element in the fluid. Thus, on this argument, there is really no proper way in which one can speak of a "velocity" microphone. Two distinguishing conditions are laid down by the author. A.B.Wood

534.232

5737. THE OUTPUT OF A QUARTZ TRANSDUCER OSCILLATING IN ITS FUNDAMENTAL AND HIGHER HARMONICS. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 145, No. 4, 511-14 (1956).

The output at fundamental, 3rd harmonic and 5th harmonic have been measured by the calorimetric method keeping the crystal amplitude the same. The output is found to be much less than that one can expect from theoretical considerations. A.

534.24/.25

5738. OUTLINING EFFECT IN ULTRASONIC IMAGES. E.E.Suckling and W.R.Maclean.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 502-3 (May, 1956).

Acoustical shadows observed in the transmission of sound through biological material are accounted for by refraction and total reflection. A.

534.39 : 534.321.9

5739. HAEMOLYTIC AND CHEMICAL ACTION OF ULTRASONIC RADIATION. THE INFLUENCE OF FREQUENCY AND PRESSURE. Y.Simonot.
C. R. Acad. Sci. (Paris), Vol. 242, No. 10, 1270-2 (March 5, 1956). In French.

The haemolysis of erythrocytes and the liberation of iodine from KI solution, over the frequency range 356-3000 kc/s, depend on whether the system is free from, or saturated with, gas, since the degree of cavitation varies. Hence pressure effects of ultrasonic radiation should be studied under conditions of complete saturation. R.Reed

534.39 : 534.321.9

5740. ON THE EXPERIMENTAL DETERMINATION OF THE STRAIN APPLIED BY ULTRASONIC WAVES ON OBSTACLES. B.Ozdogan.
J. Phys. Radium, Vol. 16, No. 12, 902-7 (Dec., 1955). In French.

A novel method is described for measuring the effect of ultrasonic waves on flat, partially reflecting surfaces. The materials, in the form of flat circular disks, are mounted at one end of a rigid rod, the other end being counterpoised. The rod is then suspended, by means of a phosphor bronze suspension wire, in water, through which the ultrasound is propagated. The deflection of the disk is measured using the conventional mirror and light beam. The absorption of stearine is found to be greater than that of paraffin wax (at 1.5 Mc/s) and in general it is concluded that the absorption coefficient of a surface depends upon the angle of incidence and in fact increases with it. T.C.Toye

534.6

5741. ON REFERENCE QUANTITIES FOR LEVELS. R.W.Young.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 499-500 (May, 1956).

Three criteria for the selection of reference quantities particularly for acoustic power levels are briefly discussed. The reference power should be sufficiently small for most field measurements of power level to be positive. Secondly, it should be easy to explain what the reference power is, and thirdly it should be convenient for calculations. The micromicrowatt is suggested as most nearly meeting these criteria. G.F.Hodsman

534.6

5742. MEASUREMENTS ON ACOUSTIC QUADRIPOLES BY A RESONANCE METHOD. M.A.Ferrero and G.G.Sacerdote.
Pubbl. Ist. Elettrotec. Naz. Ferraris, No. 401-3, 5-15 (1955). In French.

The authors have developed a method due to C.M.Harris (Abstr. 3199/1948) for the measurement of acoustic impedances, by extending this method to measurements on acoustic quadripoles. The method is based on analogous electric wave propagation in a line. In the case of a purely reactive quadripole the resonant frequencies are derived. Various types of acoustic quadripoles are discussed. A.B.Wood

534.

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78 : 621.395.4

5743. THE VOBANC — A TWO-TO-ONE SPEED BAND-WIDTH REDUCTION SYSTEM. B.P.Bogert.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 399-404 (May, 1956).

The Vobanc (VOice BANd Compressor) is a speech bandwidth reduction system which provides a reduction of two in transmission channel band-width, without a comparable loss in articulation. A description is given of an experimental system and results obtained with it are described. A

534.843

5744. ON THE SOUND LEVEL OF NOISE IN CORNERS, AT THE EDGES AND ON THE WALLS OF CLOSED ROOMS. W.Wöhle.
Hochfrequenztech. u. ElektAkust., Vol. 64, No. 5, 158-60 (April, 1956). In German.

It is shown on theoretical grounds that the sound intensity in the corners (3 surfaces meeting), edges (2 surfaces meeting and surfaces of walls, compared with that in the room (remote from the walls) is increased by 9 dB, 6 dB and 3 dB respectively – the room being assumed rectangular. Experiments have been made to examine this relationship. In a room 6.17 m long, 3.42 m wide and 3 m high (volume 63 m^3) observations were made in the octaves 200-400 c/s and 37.5-75 c/s, with the following results

	(a) 200-400 c/s	(b) 37.5-75 c/s.
wall v. room	2.7 dB	3.2 dB
edge "	6.0 dB	6.2 dB
corner "	8.4 dB	9.4 dB

Although the corners of the room were not exact right angles, the experimental results are in good agreement with the theory A.B.Wood

534.845

5745. THE APPEARANCE OF COUPLED VIBRATIONS IN HOLLOW RESONATORS WITH GRATINGS. E.Kohlsdorf.
Hochfrequenztech. u. ElektAkust., Vol. 64, No. 5, 160-2 (April 1956). In German.

The use of hollow (Helmholtz) resonators mounted behind gratings as a means of absorbing low frequency sounds has been described by various authors. The present paper deals with the resonator and the grating as a coupled system, and the equivalent electrical circuits are given. Experiments reveal the double resonances predicted by the theory. A.B.Wood

534.845

5746. THE SOUND ABSORPTION COEFFICIENT OF HOLLOW RESONATORS AND ITS DEPENDENCE ON THE ARRANGEMENT. E.Kohlsdorf.
Hochfrequenztech. u. ElektAkust., Vol. 64, No. 5, 162-4 (April, 1956). In German.

Discusses the effect of varying the distribution of hollow resonators (with gratings), on the absorption properties of the walls of a room. Linear and surface arrangements are considered and curves of absorption coefficients in relation to frequency are given. Consideration is also given to the cases where the hollow resonators are damped by absorbent material ("piatherm"). A.B.Wood

534.845

5747. UNDERWATER SOUND ABSORBING STRUCTURES. W.S.Cramer and T.F.Johnston.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 501-2 (May, 1956).

Some historical background on the use of metal-loaded rubbers for acoustical purposes is presented. Data are given which show that the performance of sound absorbing wedges is improved by adding air-filled cylindrical holes. A.

534.846

5748. THE ACOUSTICS OF THE AUDITORIUM OF THE STATE OPERA HOUSE BERLIN, UNTER DEN LINDEN. W.Reichardt.
Hochfrequenztech. u. ElektAkust., Vol. 64, No. 5, 134-44 (April, 1956). In German.

Reference is made to the three main requirements of modern acoustics in estimating the acoustic suitability of a room or auditorium, viz. the diffusivity, the clarity, and the reverberation time. These qualities have been discussed in earlier papers by E.Meyer, W.Kuhl, R.Thiele and others. The present paper deals with a study of the State Opera House in Berlin. Sectional drawings of the auditorium are reproduced and discussed in relation to the three acoustic characteristics mentioned above. C.R.O. records of pulses, as observed from different seating positions in the auditorium are reproduced to illustrate diffusivity and reverberation time and to indicate objectionable echo, if any. A comparison is made between full scale observations in the actual auditorium and those made with a model. A.B.Wood

534.846

5749. PULSE TECHNIQUES FOR ACOUSTICAL MEASUREMENTS IN BROADCAST STUDIOS. R.K.Vepa and N.K.Trivedi.
Indian J. Phys., Vol. 29, No. 8, 369-79 (Aug., 1955).

In recent years, the concept of reverberation time as the sole criterion of good acoustics in a test enclosure has yielded to an emphasis on the manner of sound decay in the enclosure. Few techniques using short impulse sounds have been developed for this purpose and this paper describes the particular method employed in All India Radio for the acoustic testing of broadcast studios. Results obtained in a typical studio in the Broadcasting House, New Delhi, are described and are interpreted on the basis of the acoustical treatment in it. Finally, a discussion of the advantages and limitations of the new techniques are given, together with a summary of the latest advances in the subject in other countries. A.

OPTICS. RADIATION. SPECTRA 535

535.232.5

5750. SPECTRAL EMISSIVITY OF RHENIUM. D.T.F.Marple.
J. Opt. Soc. Amer., Vol. 26, No. 7, 490-4 (July, 1956).

This was measured at temperatures between 1537° and 2772° C for wavelengths between 0.35μ and 2.8μ. The emissivity at 0.65μ agrees well with previous measurements for temperatures below 2200° C, and disagrees only slightly above this temperature. The method and equipment used in the measurements are discussed, and the errors are analysed. The measured emissivities, and the temperature coefficient of emissivity are compared with the predictions of the Hagen-Rubens relation. A.

535.317

5751. CATADIOPTRIC OBJECTIVE WITH A LARGE APERTURE. A.Arnulf, J.Ouillet and G.Penciolelli.
J. Phys. Radium, Vol. 16, No. 12, 84S - 85S (Dec., 1955). In French.

An f/1 objective with a flat field of 5° (total angle) is described. The corrector system consists of two lenses of similar glass with equal and opposite powers. A spot diagram is given for the edge of the field. R.W.Fish

535.317.25

5752. INFLUENCE OF PRIMARY COMA AND ASTIGMATISM UPON THE LOW CONTRAST PHOTOGRAPHIC RESOLVING POWER OF A CAMERA LENS. N.Murcott.
J. Opt. Soc. Amer., Vol. 46, No. 7, 552-4 (July, 1956).

The decrease in low-contrast photographic resolving power of a 20 inch focal length f/5.5 camera lens due to the introduction of primary coma and astigmatism was investigated and compared. The decrease is of the same order of magnitude for both aberrations, the resolving power being halved on introducing less than ten wavelengths. A.

535.317.6

5753. CONTRIBUTIONS ON OPTICAL IMAGES. II. S.Mohorovičić.
Optik, Vol. 13, No. 5, 224-6 (1956). In German.

For Pt I see Abstr. 8581 (1955). The geometric construction for the refracted ray at a plane surface is deduced from Snell's law, and it is shown that a similar construction may be used at the tangent plane to a spherical surface, if the fictional refractive index suggested by Hackl is used. R.W.Fish

535.317.6 : 535.833

5754. A METHOD FOR THE DETERMINATION OF A GLASS COMBINATION FOR A CEMENTED TELESCOPE OBJECTIVE. Y.Arvola.
Optik, Vol. 13, No. 5, 227-33 (1956). In German.

A set of equations is derived which allow the monochromatic design of a cemented doublet having required residuals of spherical aberration and coma. Further equations then allow dispersions to be allocated to the glasses to obtain a required state of achromatism. An example of the method is given. R.W.Fish

535.321

5755. RAPID AND ACCURATE MEASUREMENTS OF REFRACTIVE INDEX IN THE INFRARED. E.D.McAlister, J.J.Villa and C.D.Salzberg.
J. Opt. Soc. Amer., Vol. 46, No. 7, 485-7 (July, 1956).

Modification of a Perkin-Elmer Model 12-C spectrometer is described. The calibration of the instrument and the measurement technique used are discussed. The results obtained from measurements on a typical glass sample are presented. A.

535.322.4

5756. REFRACTOMETER FOR GLASS CONTROL. J.W.Forrest and H.W.Straat.
J. Opt. Soc. Amer., Vol. 46, No. 7, 488-9 (July, 1956).

A refractometer of high precision, designed for glass control in tank operations and for use by unskilled personnel in the manufacturing stage, has been designed and built. A.

535.322.4

5757. A FLUORESCENT EYEPIECE FOR REFRACTION MEASUREMENTS IN THE NEAR ULTRAVIOLET. R.Servant and J.Duroux.
J. Phys. Radium, Vol. 16, No. 12, 98S - 99S (Dec., 1955). In French.

A simple fluorescent eyepiece is made by placing a thin sheet of fluorescent material in contact with the cross-lines of the eyepiece of a refractometer. Some practical details are given. R.W.Fish

535.33

5758. MEASUREMENT OF INTERFEROMETRIC SECONDARY WAVELENGTH STANDARDS IN THE NEAR INFRARED. D.H.Rank, J.M.Bennett and H.E.Bennett.
J. Opt. Soc. Amer., Vol. 46, No. 7, 477-84 (July, 1956).

High-precision absolute interferometric wavelength determinations in the lead sulphide region of the infrared are reported. Very thin silver films were used to coat the etalon plates. In this way sufficiently high reflectivity in the visible region for high precision measurements without prohibitively high absorption in the infrared was obtained. In addition the correction due to phase penetration in these films is relatively small. The "Stadia Method", which was used for all measurements, made it possible to achieve a precision in wavelength measurements using energy integrating detectors comparable to that which may be obtained photographically in the visible using high-reflectivity films. In addition a technique was developed which made it possible to measure absorption lines

interferometrically relative to an emission line. Three infrared wavelengths of Hg^{198} were measured in emission and the wavelengths of P(16), P(10), P(1), R(7), R(14) and R(17) of the 002 band of HCN were measured in absorption relative to Hg^{198} λ5460 A. The band origin ν_0 of the 002 band was determined from these measurements using values of B' and B'' previously reported from measurements on lines of high J number. The band constants were then recomputed using the new value of ν_0. Final results are:

Hg^{198}	λ10 140 A	$9859.4342 \pm 0.002\ cm^{-1}$
Hg^{198}	λ13 570 A	$7366.866 \pm 0.005\ cm^{-1}$
Hg^{198}	λ15 295 A	$6535.8855 \pm 0.002\ cm^{-1}$

002 band of HCN

$\nu_0 = 6519.614_8 \pm 0.003\ cm^{-1}$
$B' = 1.45706_3$
$B'' = 1.47822_6$. A.

535.33.03

5759. SIMPLE DEVICE TO CONTROL THE ATMOSPHERE FOR ARC SPECTROSCOPY. J.W.Mellichamp.
J. Opt. Soc. Amer., Vol. 46, No. 5, 359-60 (May, 1956).

Briefly describes a simple arc chamber, of demountable design, useful for the spectroscopic analysis of solids in controlled atmospheres. As an example, the detection of boron in silicon is shown to be greatly facilitated by the use of argon, rather than air, as arc gas. J.D.Craggs

535.33.03 : 621.316.721

5760. CONSTANT CURRENT SOURCE FOR DIRECT CURRENT ARCS. N.T.van der Walt.
Rev. sci. Instrum., Vol. 27, No. 3, 157-61 (March, 1956).

A method is described by means of which the direct current of a spectrochemical arc is kept constant at any value between $\frac{1}{2}$ and $20\frac{1}{2}$ A in steps of $\frac{1}{2}$ A, independent of arc gap or the material to be excited. The principle involved is phase control on the grids of thyratrons and the design features which affect this particular application are discussed. A.

535.33.07 : 535.339

5761. ON THE TRANSMISSION OF MONOCHROMATORS. G.Bauer.
Z. Phys., Vol. 145, No. 3, 279-300 (1956). In German.

Expressions are deduced for the transmission of single, double and multiple monochromators in terms of the prism dispersions and the slit widths, for a uniform continuous spectrum. Diagrams show the wavelength–energy distribution of the emergent radiation in special cases. G.F.Lothian

535.33.07

5762. COMA CORRECTION IN SPECTROMETERS WITH SPHERICAL CONCAVE MIRRORS. W.Leo.
Z.angew. Phys., Vol. 8, No. 4, 196-201 (1956). In German.

The Czerny principle of coma correction in reflecting systems can be extended to the case of dispersing systems by taking into account the ratio of the beam diameters incident on and emerging from the dispersing element. An infrared monochromator is described based upon this principle and the measured ray paths are shown. R.W.Fish

535.333 : 539.132

5763. ON A SUPPOSED PREDISSOCIATION IN THE SPECTRUM OF AlO. A.Lagerqvist, N.E.Nilsson and R.F.Barrow.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 356-7 (April, 1956).

Examination of the 0, 0 band of the $^2\Sigma - ^2\Sigma$ system with high resolving power shows that a supposed predissociation at P(129) is not real. Other reported predissociations in this system may also be illusory. R.F.Barrow

535.338.32

5764. THE YIELD OF RESONANCE FLUORESCENCE OF Na IN A FLAME. A.L.Boers, C.T.J.Alkemade and J.A.Smit.
Physica, Vol. 22, No. 4, 358-60 (April, 1956).

The fluorescence yield for the D lines has been determined in a propane-air flame using a chopped light-beam system. For small amounts of Na, it is 0.04 and leads to a value of $24 \times 10^{-16}\ cm^2$ for the collision cross-section under flame conditions. The error in Na-reversal temperature due to lack of radiation equilibrium will not exceed 8^0. A.G.Gaydon

535.338.333

5765. ON THE ISOTOPE DISPLACEMENT IN THE SPECTRUM OF Gd. H.Kopfermann, L.Krüger and A.Steudel.
Naturwissenschaften, Vol. 43, No. 8, 175-6 (1956). In Germa

A characteristic jump in isotope displacement was observed between Gd^{152} and Gd^{154} on enriched samples. It is similar to that already known to occur in Sm and Nd, and is similarly caused by the higher deformation of nuclei with 90 neutrons with respect to those with 88 neutrons. L.Pincherle

535.338.4 : 539.132

5766. ANALYSIS OF THE (0, 1) AND (1, 2) BANDS OF THE $^2\Delta - ^2\Pi$ SYSTEM OF CH. N.H.Kiess and H.P.Broida.
Astrophys. J., Vol. 123, No. 1, 166-71 (Jan., 1956).

The (0, 1) and (1, 2) bands of the $^2\Delta - ^2\Pi$ system of CH, lying in the region of 4890 A, have been measured and analyse Molecular constants for vibration, rotation and term splitting have been determined. A.

535.338.42

5767. ROTATIONAL ANALYSIS OF THE SINGLET SYSTEM B OF ZIRCONIUM OXIDE. L.Akelind.
Naturwissenschaften, Vol. 43, No. 5, 103 (1956). In German.

The constants obtained from the 0,0 and 1,0 bands are: $B_0'' = 0.416_8$, $B_v' = 0.396_4 - 0.002_6\,(v' + 1/2)$. R.F.Barrow

535.34.03

5768. FURTHER ASPECTS OF THE THEORY OF THE MASER. K.Shimoda, T.C.Wang and C.H.Townes.
Phys. Rev., Vol. 102, No. 5, 1308-21 (June 1, 1956).

The theory of the molecular transitions which are induced by the microwave field in a maser and the effects of various design parameters are examined in detail. It is shown that the theoretical minimum detectable beam intensity when the maser is used as a spectrometer for the 3-3 line of ammonia is about 10^9 molecules/sec under typical experimental conditions. Various systematic frequency shifts and random frequency fluctuations of the maser oscillator are discussed and evaluated. The most prominent of the former are the "frequency-pulling" effect, which arises from detuning of the cavity, and the Doppler shift due to the asymmetrical coupling of the beam with the two travelling-wave components of the standing waves which are set up in the cavity. These two effects may produce fractional shifts as large as one part in 10^9. If adequate precautions are taken, however, they can be reduced to one part in 10^{10} or possibly less. The random fluctuations are shown to be of the order of one part in 10^{13} under typical operating conditions. For molecular beams in which the electric-dipole transition is used, the TM_{010} mode is usually the most suitable for the maser; while in atomic beams in which magnetic transitions are utilized, the TE_{011} mode is to be preferred. A.

535.343 : 535.372

5769. ABSORPTION, FLUORESCENCE, AND ENERGY LEVELS OF THE DYSPROSIUM ION. G.H.Dieke and S.Singh.
J. Opt. Soc. Amer., Vol. 46, No. 7, 495-9 (July, 1956).

The absorption and fluorescence spectra of $DyCl_3 \cdot 6H_2O$ have been observed at 4.2°K and 77°K. This makes an analysis of the low-lying levels possible including their Stark splitting. The strong lines have been interpreted as transitions between the ^6H, ^6P and ^6F multiplets. The Zeeman effect gives a splitting of $s_1 = 6.73$ if the acute bisectrix is parallel to the field. A.

535.343

770. ANALYSIS OF THE SPECTRA AND STATES OF SOME ARE EARTHS IN MONOCLINIC CHLORIDE SINGLE CRYS-ALS. I. HOLMIUM CHLORIDE, $HoCl_3.6H_2O$. H.G.Kahle.
. Phys., Vol. 145, No. 3, 347-60 (1956). In German.

Absorption spectra of Ho chloride and (HoY) chloride are ieasured with a dispersion of 1 A/mm at temperatures down) 14°K. The spectra are very similar and can be explained y assuming an electrical field of symmetry C_2 acting on the o^{+++} ions. The perturbation theory is used to calculate iatrix-elements from the measured splitting of the electronic evels. An anisotropic contraction of the crystal lattice is hown by the shifting of these multiplets with changing temper-ture. C.Turner

535.343

771. ANALYSIS OF THE SPECTRA AND STATES OF OME RARE EARTHS IN MONOCLINIC CHLORIDE SINGLE RYSTALS. II. ERBIUM CHLORIDE, $ErCl_3.6H_2O$.
.G.Kahle.
. Phys., Vol. 145, No. 3, 361-7 (1956). In German.

The absorption spectrum of Er^{+++} in (ErY) chloride is ieasured with a dispersion of 1 A/mm at temperatures down) 14°K. A theoretical analysis is based on a crystal field of $_2$-symmetry acting on the Er^{+++} ion. C.Turner

535.343

772. ABSORPTION SPECTRA OF BENZENE AND BEN-ENE-d_6 IN THE VACUUM ULTRAVIOLET. P.G.Wilkinson.
anad. J. Phys., Vol. 34, No. 6, 596-615 (June, 1956).

The absorption spectra of benzene and benzene-d_6 have een photographed from 1300 A to 1850 A in the first order of 21 ft normal incidence vacuum spectrograph. The band nalysis resulted in the identification of four Rydberg series over one hundred vibrational bands) in each molecule, con-erging to ionization potentials of 9.247 eV (benzene) and .251 eV (benzene-d_6). Progressions of the ν_2, ν_{18} and ν_{20} ibrations are associated with most of the 31 observed Rydberg ransitions, and vibrational constants are tabulated for each. he strong intensity and the unusual length of the upper state $_{18}$ (e_{2g}) progression in comparison with the $\nu_2(a_{1g})$ progression re interpreted in terms of the Jahn—Teller theorem, and it s concluded that the stable equilibrium nuclear configuration n the Rydberg states is of D_{2h} symmetry. A.

535.343

773. THE ABSORPTION BAND OF VITREOUS SILICA AT 420 A; GERMANIUM IMPURITY AND OXYGEN LOSS.
.Garino-Canina.
. R. Acad. Sci. (Paris), Vol. 242, No. 16, 1982-4 (April 16, 956). In French.

The 2420 A band is attributed to the presence of GeO_2 in he silica which is slightly reduced and produces oxygen acancies which form the absorbing centres. These can mi-rate at elevated temperatures in an applied electric field. G.F.J.Garlick

535.343 : 539.132

774. ON THE ROTATION SPECTRUM OF A SYSTEM OF WO DIATOMIC MOLECULES IN ELECTROSTATIC INTER-CTION. L.Galatry and B.Vodar.
. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1871-3 (April 9, 956). In French.

An extension of an earlier calculation (Abstr. 5313/1955) o obtain the selection rules for the rotation spectrum of a ompressed mixture of a polar and a non-polar gas, assuming ipole-induced dipole and dipole—quadrupole interactions. R.F.Barrow

535.343

5775. SOLVENT EFFECTS IN AROMATIC $\pi-\pi$ ELEC-TRONIC SPECTRA. J.Ferguson.
. chem. Phys., Vol. 24, No. 6, 1263 (June, 1956).

Discussion of solvent-induced frequency shifts and inten-sity changes for absorption bands of aromatics shows that the two effects are not necessarily correlated. Dispersion forces may be dominant in crystal shifts as well as in solvent shifts. J.Hawgood

535.343

5776. SPECTRA AND QUANTUM STATES OF THE EUROPIC ION IN CRYSTALS. I. ABSORPTION SPECTRUM OF ANHYDROUS EUROPIC CHLORIDE. E.V.Sayre and S.Freed.
J. chem. Phys., Vol. 24, No. 6, 1211-12 (June, 1956).

Anhydrous europic chloride and single crystals of europic chloride dissolved in a preponderant proportion of isomor-phous lanthanum chloride could be prepared so that they were sufficiently free of europous chloride to permit the study of their absorption spectra down to 3900 A. The crystal struc-ture of these preparations was proved to be UCl_3 type through the use of a trace of praseodymium chloride as an internal indicator. Because this structure is so well substantiated and is free of the ambiguity inherent in the structure of hydrated salts, the spectrum of these crystals provides a secure basis for resolving the conflicting interpretations of earlier spec-trum analyses. The polarized spectra indicate that lines in the yellow, gree, and blue visible regions arise from upper states with J values of 0, 1 and 2 as proposed by Joos and Hellwege rather than J's of 0, 2 and 3 as proposed by Gobrecht. A.

535.343 : 535.372

5777. SPECTRA AND QUANTUM STATES OF THE EUROPIC ION IN CRYSTALS. II. FLUORESCENCE AND ABSORPTION SPECTRA OF SINGLE CRYSTALS OF EUROPIC ETHYLSUL-FATE NONAHYDRATE. E.V.Sayre and S.Freed.
J. chem. Phys., Vol. 24, No. 6, 1213-19 (June, 1956).

From the polarization properties of the fluorescence spectrum of single crystals of europic ethylsulphate nonahy-drate it was possible to determine the multipole character of transitions, the energies and quantum nature of the seven levels of the ground state multiplet of the europic ion, and the group character of the sublevels into which these states are split by the crystal field. Such an analysis was made of all pure, uncoupled electronic transitions in the fluorescence spec-trum. The analysis revealed that the rare earth ion is pre-dominantly perturbed by a field of D_{3h} symmetry, arising from the water molecules of hydration immediately surrounding it. Upon this field is superimposed a weaker one of lower sym-metry, C_{3h}, arising from the lattice as a whole. All transitions involving a change of J of one appeared as magnetic dipole radiation. All others appeared as forced electric dipole tran-sitions, including one which would have been fully allowed as a magnetic dipole transition. A similar analysis of the absorp-tion spectrum in the near ultraviolet was only partially success-ful because of the superposition of the split levels of some of the upper states. It was in accord with the analysis of the fluorescence spectrum and from it was determined the multi-pole nature of the transitions and the quantum nature of some of the more isolated upper states. A.

535.343

5778. ELECTRONIC ABSORPTION SPECTRUM OF THE THIOPHOSGENE MOLECULE. L.Burnelle.
J. chem. Phys., Vol. 24, No. 3, 620 (March, 1956).

Four band systems covering 2390-7000A have been meas-ured and the nature of the corresponding transitions suggested. G.F.Lothian

535.343

5779. INFRARED SPECTRA AND MOLECULAR CON-STANTS OF GASEOUS TRITIUM BROMIDE AND TRITIUM CHLORIDE. L.H.Jones and E.S.Robinson.
J. chem. Phys., Vol. 24, No. 6, 1246-9 (June, 1956).

The infrared spectra of TCl^{35}, TCl^{37} and $TBr^{79,81}$ have been observed using a CaF_2 prism. The notation $TBr^{79,81}$ indicates the natural isotopic mixture of Br^{79} and Br^{81}, and

lack of spectral resolution of the two isotopes. A least-squares treatment of the data yielded the following molecular constants for $TBr^{79,81}$, TCl^{35} and TCl^{37}, respectively:

ν_0 =	1519.26,	1739.10,	1735.51 cm^{-1}
B_e =	2.899,	3.746,	3.723 cm^{-1}
α_e =	0.046,	0.061,	0.066 cm^{-1}
D_e =	4.5×10^{-5}	7.7×10^{-5}	6.8×10^{-5} cm^{-1}

A.

535.343

5780. ROTATION-VIBRATION SPECTRA OF DEUTERATED WATER VAPOR. W.S.Benedict, N.Gailar and E.K.Plyler.
J. chem. Phys., Vol. 24, No. 6, 1139-65 (June, 1956).

Spectra of heavy water have been obtained under high resolution between 1.25-4.1 μ (2400-8000 cm^{-1}). Approximately 4500 lines have been measured, and the majority of them analysed into ten bands of D_2O and nine bands of HDO. The analysis is described in some detail, spectra of all bands are shown and a partial table of lines and a complete table of energy levels are presented. The vibration-rotation constants are derived and compared with those of H_2O. A.

535.343

5781. INFRARED ABSORPTION SPECTRA OF COMPLEX COBALT COMPOUNDS. D.G.Hill and A.F.Rosenberg.
J. chem. Phys., Vol. 24, No. 6, 1219-31 (June, 1956).

The spectra of finely powdered salts were obtained in the 2 to 15 micron region. Complexed ammonia shows four absorption bands, at approximately 3000, 1600, 1350 and 850 wave-numbers. A possible assignment of three of these to N–H vibrations and the lowest to a rocking vibration, as proposed by Mizushima, is discussed. In the trisethylenediamine and hexanitrito complexes a frequency similar to the rocking vibration persists, but other frequencies characteristic of the particular ligands appear instead of N–H bands. A shift in the absorption maxima as the anions are changed shows that the fields of the anions are of importance. Fine structure observed in some of the strong absorption bands might be combinations with lattice vibrations. A comparison of the absorption spectra of certain hexammines obtained from deposited pure powders and from pressed KBr plates shows differences in details, which may be interpreted as indicating dissociation of the cobalt salt in the pressed KBr plate and an essentially liquid structure for the latter. The series of complex cobalt compounds whose infrared spectra were reported previously has been extended to include a number of hexammines with various anions and several similar series of pentammines. A comparison has been made with a series of hexanitrito cobalt compounds and trisethylenediamine salts. The spectra of some of the compounds mentioned earlier have been remeasured and the range has been extended to the whole spectrum obtainable with a rocksalt prism. This has demonstrated greater complexity in the spectra than was first imagined, but has led to a better understanding of them. Special care has been taken to insure the purity of all salts used. A.

535.343

5782. DETERMINATION OF ACCURATE WATER VAPOR CALIBRATION POINTS FOR PRISM SPECTROMETERS IN THE REGION 1330-2100 cm^{-1}. L.H.Jones.
J. chem. Phys., Vol. 24, No. 6, 1250-2 (June, 1956).

The spectrum was observed with a CaF_2 prism in a double-pass spectrometer. A Friedel-McKinney equation (Abstr. 1805/1948) which was successful in determining frequencies for TBr and TCl was used to determine the water vapour frequencies. Many of these water vapour frequencies are presented as the best available calibration points in the 1300-2100 cm^{-1} region, accurate to $\pm$ 0.3 cm^{-1}. A.

535.343

5783. INFRARED TRANSMISSION OF SYNTHETIC ATMOSPHERES. V. ABSORPTION LAWS FOR OVERLAPPING BANDS. D.E.Butch, J.N.Howard and D.Williams.
J. Opt. Soc. Amer., Vol. 46, No. 6, 452-5 (June, 1956).

For Pt IV, see Abstr. 5565 (1956). Although Lambert's law $T_\nu = e^{-k_\nu w}$ presumably applies to the absorption of gases in the infrared, the experimentally observed transmission T_ν' cannot be expressed by a simple relation of this type. It is observed, however, that in regions where the atmospheric carbon dioxide and water vapour absorption bands overlap $T_\nu'(CO_2 + H_2O) = T_\nu'(CO_2)\cdot T_\nu'(H_2O)$ provided the total pressur P is constant. It is found that the total absorption $\int A_\nu d\nu$ for a synthetic atmospheric sample containing water vapour, carbon dioxide, and nitrogen can be expressed as $\int A_\nu d\nu = \int A_\nu(H_2O)d\nu + \epsilon\int A_\nu(CO_2)d\nu$, where $\int A_\nu(H_2O)d\nu$ and $\int A_\nu(CO_2)d\nu$ are given by the empirical relations obtained in earlier studies in the present series and ϵ is a fraction, which can be expressed in terms of the total absorption by water vapour. A.

535.343

5784. SPECTROSCOPY AT RADIO AND MICROWAVE FREQUENCIES. D.J.E.Ingram.
London: Butterworths Scientific Publications (1955) xi + 332 p

Review in Brit. J. appl. Phys., Vol. 7, No. 5, 197 (May, 1956).

535.345

5785. TRANSMISSION OF BARIUM FLUORIDE CRYSTAL IN THE ULTRAVIOLET. T.A.Chubb.
J. Opt. Soc. Amer., Vol. 46, No. 5, 362-3 (May, 1956).

A transmission curve is given; it shows a sharp cut-off at λ = 1345 A. G.F.Lothian

535.345 : 539.11

5786. OPTICAL ABSORPTION OF COPPER AND SILVER AT 4.2°K. M.A.Biondi.
Phys. Rev., Vol. 102, No. 4, 964-7 (May 15, 1956).

Measurements of the optical absorption of copper and silver are made over the wavelength range 0.3-3.3μ at a temperature of 4.2°K where the classical mean free path of the conduction electrons is much greater than the depth of penetration of the electromagnetic field. The absorptivity is determined calorimetrically, i.e., from the temperature rise produced in the sample by the absorption of the incident radiation. In the infrared ($\lambda > 1.5\mu$) the absorptivity, A, is found to be independent of wavelength. The measured values, A = 0.0050 for copper and A = 0.0044 for silver, are in good agreement with the values obtained from theory. These results suggest that the infrared absorptivity results from absorption of photons by conduction electrons (a) during diffuse internal reflection of the electrons from the surface of the metal and (b) during phonon-generating collisions in the skin-depth layer. A.

535.345

5787. OPTICAL ABSORPTION OF PURE SILVER HALIDES. F.Moser and F.Urbach.
Phys. Rev., Vol. 102, No. 6, 1519-23 (June 15, 1956).

The a sorption spectra of pure silver bromide and silver chloride crystals grown from the melt have been measured in and near the so-called "absorption edge", where the absorption coefficient increases very rapidly with frequency. The temperature-dependence of the absorption edge has also been investigated. More limited data have been collected on the absorption spectra of mixed AgBr-AgCl and AgBr-AgI crystals. The requirements for an accurate measurement of the absorption edge in pure materials are discussed briefly, and it is estimated that the room-temperature data reported here are accurate to somewhat better than 10%. These new data are combined with some published measurements in an effort to obtain absolute absorption spectra for silver chloride and silver bromide over a large range of absorption coefficients. A.

535.345

5788. THE LIGHT ABSORPTION OF QUARTZ GLASS BETWEEN 1470 A AND 1750 A. W.Groth and H.v.Weyssenhoff.
Z.Naturforsch., Vol. 11a, No. 2, 165-6 (1956). In German.

Values of absorption coefficient are given. Lamps with 0.1 mm quartz windows may be used for $\lambda > 1550$ A.

G.F.Lothian

535.347

5789. INFRARED ABSORPTION ANISOTROPY OF CRYSTALLINE IODOFORM. R.M.Hexter and H.Cheung.
J. chem. Phys., Vol. 24, No. 6, 1186-95 (June, 1956).

The polarized infrared spectrum of crystalline iodoform has been obtained using single crystals of thicknesses from 50 to 200 microns. Spectra were recorded with the crystals oriented with respect to the electric vector by an X-ray diffraction type goniometer, and the anisotropy of the spectrum was studied carefully as a function of angle of orientation. A complete assignment of all fundamentals was possible, including at least two of the lattice frequencies of the crystal. The anisotropic behaviour of ν_1, the C–H stretching fundamental, is such that it is possible to state that Pimental's "oriented gas model" holds within well-defined limits. It is demonstrated that a much better procedure of locating transition moment directions in crystals than the use of "dichroic ratios" is the complete goniometric study of the absorption anisotropy. Finally the "threefold degenerate" first overtone of ν_4, the C–H bending mode, was split, and the intensity ratio of its members is reported. A.

535.37

5790. ON THE STRUCTURE OF LUMINESCENT ZINC OXIDE. N.Riehl and H.Ortmann.
Z. Elektrochem., Vol. 60, No. 2, 149-51 (1956). In German.

The green emission of zinc oxide is associated with anion vacancies formed during crystal growth. Attempts to produce green emission by action of reducing agents on pre-crystallized ZnO were unsuccessful indicating that anion vacancies cannot diffuse into the lattice. G.F.J.Garlick

535.371

5791. ON THE MECHANISM OF ENERGY TRANSFER FOR SENSITIZED FLUORESCENCE IN MIXED ORGANIC CRYSTALS. H.C.Wolf.
Z. Phys., Vol. 145, No. 1, 116-24 (1956). In German.

The impurity fluorescence of one aromatic hydrocarbon in solution in another is found to be stronger than that expected from emission of the host lattice and reabsorption in the impurity but when both hydrocarbons are in solution in another compound (ethanol for example) this process agrees with the results. The absorption of naphthalene in the melt shows long-wavelength bands not found for the crystalline state or for naphthalene in solution. G.F.J.Garlick

535.375.5

5792. INTENSITY DISTRIBUTION IN THE OH REGION OF THE COMBINATION SCATTERING [RAMAN] SPECTRUM OF GYPSUM. A.I.Stekhanov.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 433-6 (1956). In Russian.

The Raman spectrum of a single crystal of $CaSO_4.2H_2O$ has lines at 3495 and 3405 cm^{-1} which are very broad and have different polarization properties. They shift to 3484 and 3408 cm^{-1} at -196°C. The frequencies are attributed to an O-H : O hydrogen bond whose frequency is double by virtue of the tunnel effect between the two minima of potential; attribution to the symmetrical and antisymmetrical vibrations of H_2O is rejected on intensity grounds. D.H.Whiffen

535.375.51

5793. ON THE INFLUENCE OF INTERMOLECULAR INTERACTIONS IN MIXTURES ON THE INTENSITY OF THE LINES OF THE COMBINATION SCATTERING [RAMAN EFFECT]. Ya.S.Bobovich and T.P.Tulub.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 189-90 (1956). In Russian.

In mixtures the integrated intensity of the Raman lines of the components may change by up to 30%; deformation vibrations are more sensitive than valency stretching modes. In mixtures of polar and non-polar molecules the lines of the non-polar component normally weaken and those of the polar component strengthen. D.H.Whiffen

535.375.56

5794. ON THE RAMAN SPECTRA OF ETHYLENE CHLORHYDRIN AND n-PROPYL CHLORIDE IN THE VAPOUR STATE. M.Mazumder.
Indian J. Phys., Vol. 29, No. 8, 361-8 (Aug., 1955).

The Raman spectra of ethylene chlorhydrin and n-propyl chloride in the vapour state at different temperatures above the boiling points, and in the liquid state at room temperature and at temperatures nearly equal to those of the vapour of corresponding liquids have been studied and compared with those reported for the solid state at low temperatures by previous workers. It is observed that the intensity-ratio of the two lines in 750 cm^{-1} and 662 cm^{-1} changes abruptly with the change from liquid to vapour phase in the case of ethylene chlorhydrin, and the same changes from about 1.0 to about 5.0 when the vapour at 130°C is heated to 180°C. This intensity-ratio, however, changes only very slightly with change of temperature of the liquid from 30°C to 130°C. In the case of n-propyl chloride the change in the intensity-ratio of the corresponding two lines is much smaller than that observed in the case of ethylene chlorhydrin, but the line 1452 cm^{-1} becomes much weaker and the frequency-shifts of the lines 728 cm^{-1} and 648 cm^{-1} increase to 742 cm^{-1} and 663 cm^{-1} respectively with vaporization of the liquid. It has been pointed out that the abrupt change in the intensity-ratio with vaporization of the liquid mentioned above cannot be explained on the assumption that two types of molecules co-exist in the liquid, the relative population of the molecules depending on their energy difference, and that a strong interaction between molecules in the liquid state is to be postulated to explain the above facts. It is also pointed out that the lines 742 cm^{-1} and 663 cm^{-1} observed in the case of n-propyl chloride in the vapour state are due to the single molecule and associated molecule respectively and the line 716 cm^{-1} observed in the case of the solid state is due to the associated molecules surrounded by regularly arranged neighbours. A.

535.376 : 541.15

5795. RADIATION-INDUCED LUMINESCENCE. I. TERTIARY AND QUATERNARY SOLUTIONS OF CYCLOHEXANE, BENZENE, p-TERPHENYL AND OXYGEN. M.Burton, P.J.Berry and S.Lipsky.
J. Chim. phys., Vol. 52, No. 9, 657-66 (Sept., 1955). In French.

Luminescence produced by Co^{60} γ-radiation was measured in mixtures of cyclohexane and benzene containing a constant molar concentration of p-terphenyl. The luminescence observed in the mixtures was higher than the sum of the values observed in the individual solvents. Oxygen quenched the luminescence less efficiently in the solvent mixtures than in a p-terphenyl solution in benzene. It also changes the relationship of the intensity of luminescence and the relative concentration of the solvents. A kinetic scheme involving energy transfer considerations is derived from the results.

M.Ebert

535.376

5796. SPECTRUM AND DECAY OF NaI. W.Van Sciver.
Nucleonics, Vol. 14, No. 4, 50-1 (April, 1956).

Spectral curves are presented of the luminescence of γ-excited NaI (10^{-3} Tl), NaI (10^{-6} Tl), and pure NaI, at several temperatures from $+20^\circ$C to -190°C. Unactivated NaI at -190°C which has high density, high luminescence efficiency, and a decay time of 3×10^{-8} sec may be a useful experimental scintillator. R.D Smith

535.376 : 539.166.08

5797. PEAK EFFICIENCY OF NaI. N.H.Lazar, R.C.Davis and P.R.Bell.
Nucleonics, Vol. 14, No. 4, 52 (April, 1956).

By measuring the ratio between the peak efficiency (probability of a gamma-ray striking the crystal producing a full energy pulse) and the total efficiency, a sodium iodide crystal has been used for absolute intensity measurements. The accuracy obtained was better than 5% and is not greatly affected by scattered radiation or other gamma radiation of different energy. R.D.Smith

535.376

5798. FIELD-INDUCED COLOR SHIFT IN ELECTRO-LUMINESCENT ZINC SULFIDE. J.F.Waymouth and F.Bitter.
Phys. Rev., Vol. 102, No. 3, 686-9 (May 1, 1956).

In a previous paper it was shown that the application of an electric field to certain electroluminescent phosphors in an equilibrium condition produced little light, but that luminescent centres were activated in some way, and radiated upon removal of the field. It is here shown that while the luminescent centres are held in the activated state, changes are taking place which are observed as a colour shift in the light radiated as a function of time held in the activated state. For certain green and blue phosphors, prompt removal of the field after activation produces green and blue bands which are also observed in operation at 60 c/s. If the field is maintained for some seconds, and then removed, these bands are suppressed and a "yellow band" appears in their place at rate determined by a temperature-dependent time constant of the order of a second at room temperature. Possible explanations of this result are discussed. A.

535 : 376

5799. NUMBER OF TRAPS AND BEHAVIOR OF EXCITED ELECTRONS IN LUMINESCENT MATERIALS. H.Kallmann and G.M.Spruch.
Phys. Rev., Vol. 103, No. 1, 94-102 (July 1, 1956).

The number of traps per unit volume in different types of luminescent materials, and the prolonged lifetimes of excited electrons due to trapping, were studied by means of curves of the rise of fluorescence with time under constant high-energy electron and alpha-particle excitation. These rise curves were taken after various dark decay periods and after different infrared irradiation conditions. They were found to be different in shape for different types of phosphors. Lifetimes longer than one week were found to occur in most of the zinc cadmium sulphides. The number of traps per unit volume responsible for lifetimes longer than about a minute was found to be of the order of 10^{15} (10^{-7} mole fraction) in the zinc cadmium sulphides, and the number responsible for lifetimes longer than a week was of the same order of magnitude. There is no direct correlation between infrared stimulability and the number of traps in which electrons remain for some time. Substances with extremely high stimulability (Fonda type) and those with extremely low stimulability both contained about the same number of these traps per unit volume. Materials with large concentrations of Ni exhibited no more such traps than those with smaller concentrations. Lack of phosphorescence is caused either by the preponderance of excited electrons of very long lifetime or by the radiationless recombination of electrons of short lifetime. Examples of each are given. It was found further that most of the electrons which remain in traps for long periods could be ejected by infrared radiation of wavelength greater than 1.25 μ, indicating that retrapping of both electrons and positive holes is of major importance. The different effects of alpha-particle excitation and electron excitation on the filling of the traps is discussed. A.

535.376

5800. EXCITATION AND DESTRUCTION OF PHOSPHORS BY HYDROGEN IONS. H.P.Gilfrich.
Z. Phys., Vol. 145, No. 2, 241-8 (1956). In German.

The diminution of luminescence is examined in a series of inorganic and organic phosphors following bombardment with H^+ ions, at an energy of 10 kV. A relation between the luminescence intensities and dosage which is obeyed except for small dosages, is given. A constant appearing in the equation depends upon the type of phosphor and the nature of the activator, but not upon the activator concentration. G.F.J.Garlick

535.394

5801. THE INFLUENCE OF THIN FILMS ON THE VISIBILITY OF THE BORDERLINE IN TOTAL REFLECTION. H.Anders.
Optik, Vol. 13, No. 4, 175-85 (1956). In German.

Thin films of refractive index $n_t < n_p$, the r.i. of a refractometer prism, can enhance the visibility of the borderline, provided the film substance does not absorb the relevant radiation and the r.i. of the test substance $n_s < n_t$. It is thus possible to obtain improvement in the visibility of the borderline in limited cases. In general, however, films lead to a deterioration in the line-visibility as is shown theoretically and confirmed with photographs. R.A.Weale

535.417

5802. INCREASE OF THE PRODUCT OF LUMINOSITY x RESOLUTION WITH INTERFEROMETERS BY EMPLOYING PATH DIFFERENCES INDEPENDENT OF THE INCIDENCE. P.Connes.
Rev. Opt., Vol. 35, No. 1, 37-43 (Jan., 1956). In French.

The discussion is restricted to the interferometers of Michelson and of Fabry–Perot. The advantages of interpolating afocal length systems in the beams are discussed. In the case of the Michelson interferometer the proposed afocal system is a convex lens followed by a concave lens. In the Fabry–Perot interferometer a mirror afocal system is described. The systems described increase the luminosity. S.Tolansky

535.43 : 535.5

5803. ON THE DEPOLARIZATION OF RADIATION IN A DIFFUSING MEDIUM. J.Lenoble.
C. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1865-8 (April 9, 1956). In French.

Using the method of Chandrasekhar, the polarization of scattered radiation is calculated for plane polarized radiation incident on an infinite medium assumed to give a scattered intensity distribution of the form $(1 + \cos\theta)^3$. The polarization is plotted as a function of scattering angle and optical depth for transparent and absorbing particles. The forward-scattered radiation is only slowly depolarized, especially for absorbing particles; this is of interest in connection with sub-marine polarization. G.F.Lothian

535.51

5804. DEGREE OF POLARIZATION OF SUBMARINE ILLUMINATION. A.Ivanoff.
J. Opt. Soc. Amer., Vol. 46, No. 5, 362 (May, 1956).

Photographic measurements at a depth of 20 metres show that the polarization may be up to 34%, according to the direction of observation. G.F.Lothian

535.51

5805. TRANSMITTANCE OF A TRAIN OF THREE POLARIZERS. R.C.Jones.
J. Opt. Soc. Amer., Vol. 46, No. 7, 528-33 (July, 1956).

The theory of the transmittance of a train of three dichroic linear polarizers is described. The incident light is supposed to be unpolarized and the first and third polarizers to have parallel orientations. A train of three polarizers differs from a train of two polarizers in that the birefringence of the middle polarizer enters importantly into the result. A very surprising fact is that the transmittance of the train does not always have its minimum value when the middle polarizer is crossed with the other two. If the cosine of the relative phase retardation of the middle polarizer lies between zero and minus one, the transmittance has a relative maximum at the crossed position and the minimum occurs at an orientation which, in the numerical case discussed, is 18.5° either way from the

crossed position. It is shown that this surprising result has an elementary quantitative explanation. The general expression for the transmittance of three (not necessarily identical) linear dichroic polarizers and various special cases are given. The simplest case that reveals the interesting behaviour just described is that in which the two outside polarizers are ideal. A.

535.514

5806. ON THE PROPERTIES OF POLARIZATION ELEMENTS AS USED IN OPTICAL INSTRUMENTS. III. ANGULAR APERTURE FUNCTIONS OF A POSITIVE DICHROIC FILM POLARIZER. L.Baxter, II.
J. Opt. Soc. Amer., Vol. 46, No. 6, 435-42 (June, 1956).

For Pt II see Abstr. 1691 (1952). Discusses the important properties that affect the use of a polarizer in applications involving large angular aperture or oblique incidence. Experimentally determined values of these properties are reported for Polaroid HN 22 polarizer, one of the best known types of high-extinction, commercially available polarizers. It is shown that these properties may be rather simply described. Equations are given from which polarization direction and transmittance of positive dichroic polarizers can be calculated for oblique rays. The calculated values agree well with the experimentally obtained values given here as well as with those for very differently constructed positive dichroic polarizers studied by previous investigators. A.

535.64 : 612.843.31

A PSYCHOLOGICAL COLOUR SPECIFICATION SYSTEM. See Abstr. 5574

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.822.17

5807. TEST OBJECTS FOR JUDGING PHASE-CONTRAST APPARATUS. E.Menzel.
Naturwissenschaften, Vol. 43, No. 7, 152-3 (1956). In German.

Test objects are required in phase-contrast work for the determination of the resolving power in depth. The method of preparing prism shaped edges in collodion films is described and the appearance of such an edge in dark and bright field, as well as phase-contrast, microscopy is illustrated. R.W.Fish

535.822.9

5808. TELEVISION MICROSCOPY. W.Köhler.
Optik, Vol. 13, No. 4, 186-91 (1956). In German.

A system is described in which an initial optical microscope forms an image scanned by a television camera. The advantages of such a system for demonstrating are explained, and the limitations in resolution and contrast are determined. R.W.Fish

535.823.5

5809. A MICROSCOPE STAGE WITH MULTIPLE MOVEMENTS. J.Combe and M.Liess.
J. Phys. Radium, Vol. 17, No. 3, 54 A - 55 A (March Suppl., 1956). In French.

A stage is described for use with nuclear photographic plates. All the working parts are below the focal plane so that large plates can be accommodated. Precise movements can be made by an hydraulic system which is hollow to allow illumination to pass through. Drawings of the stage and further practical details are given. R.W.Fish

535.832

5810. SPECTACLE TESTER. G.Vogl and S.Täcklind.
J. Opt. Soc. Amer., Vol. 46, No. 5, 361 (May, 1956).

An instrument is described which works on the same principle as a common vertometer and can be used in testing spectacle lens performance for both distant and near objects. R.W.Fish

535.834

5811. NEW METHODS IN BINOCULAR CONSTRUCTION. H.Köhler.
Optik, Vol. 13, No. 5, 216-23 (1956). In German.

The optical performance of the new Zeiss 8 x 50 and 8 x 30 binoculars is described. The objective is a separated doublet which allows a higher state of correction and a shortened overall length. The aberration curves are compared with those of previous binoculars, and some photographs of the star image throughout the field are added. The sealing of the binoculars by means of silicone rubber rings is briefly discussed. R.W.Fish

HEAT 536

536.21 : 536.48

5812. THERMAL CONDUCTIVITY OF SOLID ARGON AT LOW TEMPERATURES. G.K.White and S.B.Woods.
Nature (London), Vol. 177, 851-2 (May 5, 1956).

It is reported that between 2°K and 25°K the thermal conductivity of solid argon passes through a maximum at 7°K, and that, above 15°K, it may be approximated by the formula 0.28/T watt/cm.deg. Below 6°K the mean free path is estimated at about 10^{-4} cm, and dislocation scattering is presumed dominant. P.T.Landsberg

536.25

5813. THE TRANSPORT OF HEAT, BY FREE CONVECTION, FROM THIN WIRES HEATED BY AN ELECTRIC CURRENT IN AIR UNDER NORMAL CONDITIONS. J.Fischer and F.P.Dosch.
Z. angew. Phys., Vol. 8, No. 6, 292-7 (1956). In German.

An experimental study of the heat loss by free convection from fine platinum wires of diameters 0.022-0.1139 mm heated at 10°-600°C above the temp. of the normal ambient air (pressure 747-755.5 mm of mercury, temperature 20-22°C and relative humidity 48-52%) is reported. The results are represented by a series of graphs showing the heat loss from the wires in terms of the temperature and diameter of the wires, and are used to deduced values of the Nusselt coefficient. Previous results obtained by Fischer (Abstr. 3532/1952) are confirmed. Values of the Nusselt function within the range $Gr.Pr = 10^{-3}$-10^{-5}, Gr and Pr denoting the Grashof and Prandtl numbers,are derived from the data. J.S.G.Thomas

536.33.08

5814. THEORY AND PERFORMANCE OF METAL BOLOMETERS. R.P.Chasmar, W.H.Mitchell and A.Rennie.
J. Opt. Soc. Amer., Vol. 46, No. 7, 469-77 (July, 1956).

The ultimate limitations to the performance of a bolometer made from a classical metal are discussed and an expression derived for the noise equivalent power input of such an instrument operated under optimum conditions. This is found to be twice the value for a perfect thermal detector working at the same temperature. Details of the construction and performance of some bolometers made from thin platinum strip are given, the bolometers being operated both at room temperature and under cooled conditions. A.

536.422.1 : 548.52

EVAPORATION OF PERFECT CRYSTALS. See Abstr. 5520

536.46

5815. THE SHADOWGRAPH OF A FLAT FLAME. F.J.Weinberg.
Proc. Roy. Soc. A, Vol. 235, 510-17 (June 19, 1956).

The structure of the shadow is described. For a shadow close to the flame the temperatures in the flame giving rise to the maximum and the minimum light intensities are calculated. In air of initial temperature 18°C they are 59 and 364°C respectively. For a shadow distant from the flame a new point of reference on the shadowgraph is suggested in the first discontinuous rise in intensity. This is correlated quantitatively with a particular position and temperature in the flame. A.

536.462

5816. SUPERSONIC FLAMES THROUGH SECONDARY COMBUSTION OF ROCKET EXHAUSTS IN AIR. H.Behrens and F.Rössler.
Z. angew. Phys., Vol. 8, No. 5, 237-44 (1956). In German.

Previous experiments (Abstr. 8232/1954) on secondary combustion in rocket exhausts have been continued and it is found that whereas a continuous decrease of temperature is found along the axis of the jet from a Laval nozzle, a decided maximum temperature occurs along the longitudinal axis of cut-off nozzles burning hot powder, and a fall of temperature as burning proceeds. Temperature measurements were made by line reversal. Experiments with a drum camera and with various filters indicated that the secondary flames with temperature maxima are true diffusion flames, whereas in the flames in which there is continuous decrease of temperature secondary combustion only occurs after mixing of air in the flame, so that they are premixed flames. The decrease of temperature during burning is explained by a decrease of oxygen in the air due to mixing with combustion gases. Laval nozzles burning rather cold powder produce no secondary combustion. R.C.Murray

536.48

5817. NUCLEAR SPIN SYSTEM OF LIQUID He^3. L.Goldstein.
Phys. Rev., Vol. 102, No. 5, 1205-8 (June 1, 1956).

The entropy and heat capacity of spin disorder in liquid He^3, obtained previously, define the partial thermodynamic potentials of the spin system. These in turn lead to the spin equation of state. The energy of spin excitation, quadratic in the liquid temperature at low temperatures, tends toward the limiting value of $\frac{1}{2}kT_0$, per spin, at high temperatures, T_0 being the empirical characteristic temperature of the spin system. The partial volume expansion coefficient of liquid He^3, arising from the spin excitations, is a linear function of the temperature at low temperatures and of considerable magnitude, which might make it accessible experimentally. The effect of the spin excitations on the vapour pressure of liquid He^3 might also be separable through a careful analysis of the data over a wide temperature interval. A.

536.48

5818. THE DISTRIBUTION COEFFICIENT OF ^3He-^4He MIXTURES OF LOW CONCENTRATION AT TEMPERATURES BETWEEN 1.2 AND 2°K. D.H.N.Wansink, K.W.Taconis and F.A.Staas.
Physica, Vol. 22, No. 5, 449-64 (May, 1956).

Measurements have been made of the ratio of the vapour and the liquid concentration, C_V/C_L, of He^3-He^4 mixtures of very low concentrations at temperatures between 1.2 and 2°K, forming an addition to the experiments of Sommers. The results are in good agreement with those of Sommers. A.

536.48

5819. THE INFLUENCE OF ^3He ON THE LAMBDA POINT. B.K.Agarwal.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 408-9 (March 1, 1956).

A modification of the ideal gas model of Heer and Daunt (Abstr. 4344/1951) in which their ideal gas energy spectrum is replaced by two different empirical spectra, respectively applicable to high and low He^3 concentrations. H.London

536.4

5820. ENERGY SPECTRUM OF THE EXCITATIONS IN LIQUID HELIUM. R.P.Feynman and M.Cohen.
Phys. Rev., Vol. 102, No. 5, 1189-204 (June 1, 1956).

A wave function previously used to represent an excitati (phonon or roton) in liquid helium, inserted into a variational principle for the energy, gave an energy–momentum curve having the qualitative shape suggested by Landau; but the value computed for the minimum energy Δ of a roton was 19.1°K, while thermodynamic data require Δ = 9.6°K. A new wave function is proposed here. The new value computed for Δ is 11.5°K. Qualitatively, the wave function suggests that the roton is a kind of quantum-mechanical analogue of a microscopic vortex ring, of diameter about equal to the atom spacing. A forward motion of single atoms through the centr of the ring is accompanied by a dipole distribution of returning flow far from the ring. In the computation both the two-atom and three-atom correlation functions appear. The form is known from X-rays, while for the latter the Kirkwood approximation of a product of three two-atom correlation functions is used. A method is developed to estimate and correct for most of the error caused by this approximation, so that the residual uncertainty due to this source is negligibl A

536.483 : 538.24 : 536.5

5821. NEW MATERIALS FOR MAGNETIC COOLING AND THERMOMETRY BELOW 1°K. E.Ambler and R.P.Hudson.
Phys. Rev., Vol. 102, No. 3, 916-17 (May 1, 1956).

Suggests the use of paramagnetic salts having the $(NH_4)_3FeF_6$ structure, and reports and analyses entropy measurements for $(NH_4)_3CrF_6$ over a range of the magnetic temperature between 0.1° and 1°K. E.P.Wohlfarth

536.521

5822. PHOTOELECTRIC TEMPERATURE MEASUREMENT BY LINE REVERSAL. W.Snelleman and J.A.Smit.
Physica, Vol. 21, No. 12, 946-9 (Dec., 1955).

The human eye or photography (for u.v. line reversal temperature measurement) are replaced by a photo-cell, by allowing the line being used (e.g. of sodium), obtained from a prism spectrograph with a very narrow entrance slit, to be thrown by a mirror mounted on the vertical axis of a moving coil milliammeter on to the spectrograph exit slit. This mirror is caused to vibrate by feeding 25 c/s current to it, so that the beam vibrates across the exit slit at 50 passings per second. The intensity of the light leaving the slit is measured by a photomultiplier (RCA 1P28) connected either to a c.r.t. or to a 50 c/s a.c. galvanometer, synchronized with the 25 c/s mirror movement. A tungsten strip lamp is used as source of light. A device to eliminate self-absorption is described. R.C.Murray

536.629 : 539.16.08

A CALORIMETRIC METHOD OF DETERMINING THE ENERGY OUTPUT OF RADIOACTIVE MATERIALS. See Abstr. 5341

536.631

5823. HEAT CAPACITY OF TITANIUM BETWEEN 4°K AND 15°K. M.H.Aven, R.S.Craig, T.R.Waite and W.E.Wallace
Phys. Rev., Vol. 102, No. 5, 1263-4 (June 1, 1956).

The heat capacity of high-purity annealed titanium was determined in the temperature range 4 to 15°K. Results obtained can be represented by the equation C/T (joules-g.atom.deg^2) = $3.38 \times 10^{-3} + 2.60 \times 10^{-5}T^2$ with an average deviation of 1.57%. From this γ, the electronic specific heat coefficient, and the Debye θ are evaluated to be $(3.38 \pm 0.04) \times 10^{-3}$ joule g. atom.deg^2 and 421 ± 2°K, respectively. A.

536.631 : 548.7

5824. SPECIFIC HEAT OF A MAGNETITE CRYSTAL AT LIQUID HELIUM TEMPERATURES. J.S.Kouvel.
Phys. Rev., Vol. 102, No. 6, 1489-90 (June 15, 1956).

The heat capacity of a large natural crystal of magnetite was measured between 1.8 and 4.2°K. The specific heat, as a function of temperature, is resolved into two parts, a T^3 term that presumably is the lattice heat, and a $T^{3/2}$ term that may be identified as a spin-wave contribution to the specific heat. A.

536.631

5825. HEAT CAPACITY OF SILVER BELOW 4.2°K. T.A Rayne.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 482-3 (April, 1956).
Obtains $\gamma = (0.613 \pm 0.005) \times 10^{-3}$ joule.mol^{-1}deg^{-2}, $\theta = (226.2 \pm 0.3)$ deg K. Comparison is made with older data. E.P.Wohlfarth

THERMODYNAMICS 536.7/.8

536.7 : 530.162

5826. RELATIONSHIP BETWEEN THE RECIPROCITY THEOREMS OF ONSAGER AND OF CALLEN-GREENE. T.A.Kaplan.
Phys. Rev., Vol. 102, No. 6, 1447-50 (June 15, 1956).
Onsager's reciprocity theorem is extended to linear non-Markoffian processes; the reciprocity relation due to Callen-Greene is also extended to include the imaginary (as well as the real) part of the admittance matrix. In terms of these extensions, the two theorems are shown to be completely equivalent. A.

536.7

5827. COMPONENTS OF THE THERMODYNAMIC FUNCTIONS OF IRON. R.J.Weiss and K.J.Tauer.
Phys. Rev., Vol. 102, No. 6, 1490-5 (June 15, 1956).
The thermodynamic functions enthalpy, entropy, and free energy of alpha and gamma iron are determined from existing data. These functions are resolved into their magnetic, lattice and electronic components on the basis of additivity of the respective specific heat components. The total magnetic entropy at the melting point approaches R ln(2s + 1), where s is the unpaired spin per atom, indicating the validity of the method of separating specific heat components. A comparison plot of magnetic entropy v. temperature and saturation magnetization v. temperature qualitatively distinguishes the long- and short-range magnetic order. It is shown that the magnetic enthalpy at the melting point is of order kT_c, where T_c is the Curie temperature. It is further shown that in the absence of magnetic effects the γ lattice at absolute zero is more stable than the α lattice by approximately 130 cal/mole. Finally, the components of the free energy are appropriately modified for the iron-rich FeMn alloy in order to determine the phase boundaries. A.

536.7 : 530.145

ENTROPY IN QUANTUM MECHANICS. See Abstr. 4843

536.75

5828. AN APPROXIMATE ENTROPY DIAGRAM FOR URANIUM HEXAFLUORIDE. F.I.Havlíček.
Z. Naturforsch., Vol. 11a, No. 1, 99 (1956). In German.
The temperature—entropy chart presented in based on data reported by Katz and Rabinowitsch (Nat. Nucl. Energy Series VIII-5, New York, 1951) extrapolated using the principle of corresponding states. The chart is intended to provide information required in the uranium-235 enrichment process using a de Laval nozzle, as suggested by Becker, Bier and Burghoff (Abstr. 9838/1955). A.Gelbtuch

ELECTRICITY 537

537.12/.13 : 539.185

5829. ISOTOPIC INVARIANCE AND THE SCATTERING OF ANTINUCLEONS BY NUCLEONS. I.Ya.Pomeranchuk.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 423 (1956). In Russian.
Six processes are reduced to three unknowns; with further assumptions, namely that double charge exchange is relatively unlikely at high energies (being only one of many possible inelastic processes) and that the target particle is essentially "black" it is concluded that $\sigma_{tot}(\bar{p} + p) \cong \sigma_{tot}(\bar{p} + n)$. G.E.Brown

537.123/.133

5830. EXAMPLE OF AN ANTIPROTON—NUCLEON ANNIHILATION. O.Chamberlain, W.W.Chupp, A.G.Ekspong, G.Goldhaber, S.Goldhaber, E.J.Lofgren, E.Segrè, C.Wiegand, E.Amaldi, G.Baroni, C.Castagnoli, C.Franzinetti and A.Manfredini.
Phys. Rev., Vol. 102, No. 3, 921-3 (May 1, 1956).
The event, observed in an emulsion, is of particular interest since the visible energy release is greater than $M_p c^2$ and because of the high multiplicity of charged π-mesons. J.Hughes

537.123

5831. FURTHER ANALYSIS OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY ANTIPROTON EVENT. H.S.Bridge, D.O.Caldwell, Y.Pal and B.Rossi.
Phys. Rev., Vol. 102, No. 3, 930-1 (May 1, 1956).
Further work has confirmed the interpretation of this event previously reported (Abstr. 11441/1954). J.Hughes

537.123

5832. PRODUCTION AND ANNIHILATION OF AN ANTIPROTON IN A NUCLEAR EMULSION. R.D.Hill, S.D.Johansson and F.T.Gardner.
Phys. Rev., Vol. 103, No. 1, 250-3 (July 1, 1956).
A track connecting two high-energy stars in a nuclear emulsion has been identified as an antiproton. Ionization density and scattering measurements on the track indicate that the antiproton's energy was 710 ± 150 MeV, whereas the energy in the secondary star caused by the antiproton was certainly greater than 1460 MeV. The stars in which the antiproton originated and annihilated are described. A.

ELECTROSTATICS. DIELECTRICS 537.2

537.21 : 621.3.013

5833. AN EXTENSION OF THE CIRCLE AND SPHERE THEOREMS. G.Power.
Brit. J. appl. Phys., Vol. 7, No. 6, 218-21 (June, 1956).
The circle and sphere theorems are extended to include certain other boundaries along which either the electric potential or the current function takes a constant value. This greatly facilitates the solution of problems previously treated by ad hoc methods, especially in two dimensions where use of the method of conformal transformation can also be made. Illustrative examples are given, showing how these theorems can be applied even when fairly difficult boundary shapes are involved. A.

537.22 : 551.594

5834. ON SOME ELECTRICAL PROPERTIES OF WATER AND ICE. V.I.Arabadzhi.

Zh. éksper. teor. Fiz., Vol. 30, No. 1, 193-5 (1956). In Russian.

These properties are important in studying atmospheric electricity. Four experiments are described: (A) Positive charges obtained on ice when it is sawn or scratched. They are or order 10^{-8} coulomb per gramme of ice and depend on its temperature. (B) E.m.f. of ice polarization after the application of a direct voltage for one hour to it. It was roughly equal to 3 volts for every volt per cm applied. (C) Contact potential between water and ice was measured with a radiothorium collector. The average result was 1.5 volts. (D) The potential difference, produced in a jet of steam and water droplets at different pressures as a function of the distance from an orifice, showed a maximum of up to 3 kV/m for 6 atm at a distance of 10 m. M.W.Makowski

537.224 : 621.319.4

5835. STANDARD CAPACITORS AND THEIR ACCURACY IN PRACTICE.
Notes appl. Sci. Nat. Phys. Lab., No. 13, 10 pp. (1955).

Concerned chiefly with capacitors designed for use as laboratory standards of capacitance. Attention is drawn to various factors affecting their performance, which are inherent in their construction and method of use. Topics dealt with include air dielectric and solid dielectric capacitors; the inductance and resistance of capacitors; and the effect of leads on the measured values. It is concluded that good quality capacitors, of either air or mica dielectric, provide standards of reactance not much inferior in constancy to that of a good resistor, provided proper precautions are taken in their maintenance and use. Clamped mica capacitors of value between 0.1 and 1 μF are probably the most stable, and if exposed to moderate and uniform conditions of temperature and humidity, they should show fluctuations about their mean values which do not exceed ± 0.5 part in 10^4 in capacitance and $\pm 20\%$ in power factor, over a period of several years.
A.E.Kay

537.226

5836. DIELECTRIC BEHAVIOUR AND STRUCTURE. DIELECTRIC CONSTANT AND LOSS, DIPOLE MOMENT AND MOLECULAR STRUCTURE. C.P.Smyth.
London: McGraw-Hill Publishing Company (1955) x + 441 pp. (International Chemical Series).

Review in Nature (London), Vol. 177, 862-3 (May 12, 1956).

537.226

5837. DETERMINATION OF THE EFFECTIVE DIPOLE MOMENTS OF MOLECULES AND OF THE STRUCTURAL FACTOR OF POLAR LIQUIDS AND POLYMERS.
G.P.Mikhallov and B.I.Sazhin.
Zh. tekh. Fiz., Vol. 25, No. 10, 1696-702 (1955). In Russian.

The method presented corrects some shortcomings of Kirkwood's theory of polarization and enables the effective dipole moment $\mu\sqrt{g}$, the moment μ_0 and structural factor g to be determined from the temperature–frequency relations of ϵ' and ϵ'' of the condensed substance. Comparison with results obtained by other methods shows satisfactory agreement with these. Electrical Research Association

537.226.2

5838. EFFECTS OF PRESSURE ON THE COMPLEX PERMITTIVITY ($\epsilon' - j\epsilon''$) OF LIQUIDS. P.Caillon and E.Groubert.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1855-6 (April 9, 1956) In French.

Variation of ϵ' and ϵ'' in chlordiphenyl due to changes in viscosity with varying temperature or pressure, indicates a distribution of dipolar orientation times which becomes narrower at higher pressures. J.H.Mason

537.226.2

5839. THE DIELECTRIC CONSTANT OF CdTe.
D.de Nobel and D.Hofman.
Physica, Vol. 22, No. 3, 252 (March, 1956).

Measurements on a p-type crystal with 5.5×10^{13} cm^{-3} carrier concentration at room temperature, using gold electrodes, yielded values for ϵ of 10.9 ± 0.3 at 20°K and 11.0 ± 0.3 at 77°K. C.A.Hogarth

537.226.2 : 539.21

SOLID SOLUTIONS OF ICE AND NH_4F AND THEIR DIELECTRIC PROPERTIES. See Abstr. 5440

537.226.2

5840. NON-LINEAR CHARACTERISTICS OF FERROELECTRICS AT HIGH FIELD STRENGTHS. A.L.Khodakov.
Zh. tekh. Fiz., Vol. 26, No. 1, 51-60 (1956). In Russian.

Investigation of the relations between ϵ, tan δ and field strength for solid ferroelectric solutions. The firing conditions of the ceramics have a great influence on the non-linear phenomena. The investigation of the gradients of the reversible permittivity showed that ferroelectric phenomena appear at temperatures above Curie point. The curve of the variatio of the differential permittivity during a period was obtained b oscillograph; at saturation its maximum is almost independen of field strength. Electrical Research Association

537.226.2

5841. EFFECT OF IMPURITIES ON DIELECTRIC CONSTANT AND PIEZOELECTRIC MODULUS OF SEIGNETTE SALT. T.Kh.Chormonov.
Zh. tekh. Fiz., Vol. 26, No. 2, 323-6 (1956). In Russian.

Carefully selected and dosed admixtures during the crystallization of Seignette salts were found to alter only the external form of the crystals, but not to distort the lattice. Traces of aluminium shift upper Curie point to lower tempera tures and reduce ϵ. All the admixtures added alter the temperature-relation of the piezoelectric modulus. There is no domain structure of Seignette salt with admixtures of Al, Cu, Si, Ca, Rb between −2 and +25°C.
Electrical Research Association

537.226.2 : 621.315.612.4

5842. DIELECTRIC CHARACTERISTICS OF SOME SOLID SOLUTIONS CONTAINING BARIUM TITANATE.
N.S.Novosil'tsev and A.L.Khodakov.
Zh. tekh. Fiz., Vol. 26, No. 2, 310-22 (1956). In Russian.

Results are reported on temperature-relations of dielectric constant, losses and conductivity of solid solutions of $BaTi_3O$ and $BaSnO_3$, $BaZrO_3$, $SrTiO_3$, $PbTiO_3$, respectively. It is shown that the temperature interval of existence of the tetragonal phase may be extended and contracted by introduction of appropriate components. This can be utilized for obtaining new ferroelectric materials.
Electrical Research Association

537.226.3

5843. THE ABSORPTION OF 39 kMc/s RADIATION IN GERMANIUM. A.F.Gibson.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 488-90 (April, 1956).

At this frequency the absorption constant is given by $K = (n/c_0)[(q\sigma)/\epsilon] = 1635(\sigma/n)$ dB per metre, where $n = \sqrt{\epsilon}$, the refractive index, c_0 the velocity of light, q the electronic charge, σ the conductivity for direct current. Excellent agreement between this equation and experiment was observed from room temperature to 55°C. The disagreement between these results and those of Klinger (Abstr. 1287/1954), is discussed. W.Bardsley

537.226.3.08

5844. NEW METHOD OF MEASUREMENT OF THE COMPLEX DIELECTRIC CONSTANT AT 3000 Mc/s. APPLICATION TO THE STUDY OF A PROBLEM IN PHYSICAL CHEM-

TRY: THE ABSORPTION OF WATER ON GELS OF SILICA ND ALUMINA. J.Le Bot.
. Phys. Radium, Vol. 16, No. 12, 140S (Dec., 1955).
i French.

The sample is a cylinder perpendicular to the wide side $H_{0,1}$ rectangular waveguide, and ϵ' and ϵ'' are determined om the localized shunt admittance. D.H.Whiffen

537.226.33 : 539.133

845. ATOMIC DIPOLE MOMENTS IN MOLECULES AND IELECTRIC RELAXATION. E.Fischer.
aturwissenschaften, Vol. 43, No. 7, 153 (1956). In German.

Only 1/4 of the dipolar polarization of solutions of phenyl ether in benzene relaxes with the normal relaxation me, c. 1.2×10^{-11} sec for a molecule of this size. It is iggested that the shorter relaxation time corresponds to at for rotation of the individual phenyl rings since part of e dipole moment is affected by this motion through the π-ectron conjugation. D.H.Whiffen

537.226.33

846. DIELECTRIC RELAXATION EXPERIMENTS ON THE UESTION OF PARTICULAR MECHANISMS OF ORIENTATION OR CYCLOHEXANE DERIVATIVES AND DIPHENYL ETHER. .Dieringer.
. Phys., Vol. 145, No. 2, 184-205 (1956). In German.

The relaxation times τ were derived from measurements the frequency dependence of ϵ' and ϵ'' of chloro-, bromo- nd nitro-cyclohexane and of cyclohexane and of these liquids i dilute solution in carbon tetrachloride, and also of diphenyl ther dissolved in benzene, CCl_4, and decalin, in the metre-ave region. The concentration-dependence of τ/η (where η the viscosity) and the very short relaxation time of diphenyl-ther are somewhat anomalous, and special models are sug-ested to explain these effects. C.A.Hogarth

537.226.33

847. ON THE INFLUENCE OF THE STRUCTURE ON THE YSTERESIS BEHAVIOUR OF $BaTiO_3$ CERAMIC. .Heywang and R.Schöfer.
.. angew. Phys., Vol. 8, No. 5, 209-13 (1956). In German.

Hysteresis loops show that material having 1-micron rystallites has a larger small-signal permittivity and a much maller hysteresis loss than material with 50-micron crystal-ites. The wasp-waisted hysteresis loops obtained on first pplication of the field to the coarse-grained materials gradu-lly disappear at a rate which depends on the magnitude of the pplied field, on the temperature and on the crystallite-size: urves show the relaxation-times determined, by a method iat is described, for 50-, 80- and 100-micron crystallites ver -40°C to $+120^\circ$C with a field of 1.5 kV/cm. A brief quali-ative discussion of the relaxation is given. F.F.Roberts

537.226.8

848. NEW MEASUREMENTS OF THE DIELECTRIC TRENGTH OF COMPRESSED HYDROGEN AND NITROGEN. .Bolloud.
. Phys. Radium, Vol. 17, No. 3, 26A - 31A (March Suppl., 956). In French.

Breakdown strength of pure and impure H_2 and N_2 at high essures in uniform and nonuniform electric fields shows at N_2 has about twice the strength of H_2. Gas purity does ot appear to affect the breakdown strength of H_2 but impure has a slightly higher breakdown voltage than purified N_2. ield-controlled cathode emission determines the initiation the sparks. C.G.Morgan

537.226.8

849. NOTES ON EFFECT OF PLASTIC DEFORMATION F MONOCRYSTALS OF ALKALI-HALIDE SALTS ON THEIR ELECTRIC STRENGTH. A.A.Vorob'ev.
h. tekh. Fiz., Vol. 26, No. 2, 327-9 (1956). In Russian.

Author criticises Calderwood, Cooper and Wallance's nclusions on an increase of dielectric strength by mechanical deformations and points out that they are contradicted by the very experimental results on which authors base them, apart from being at variance with other experience available. The fact that mechanical deformations under electric fields always precede the breakdown proves that the statement objected to is fallacious. Electrical Research Association

537.226.8

5850 DIELECTRIC STRENGTH OF CRYSTALS, THEIR MECHANICAL AND THERMAL STABILITY AND LATTICE ENERGY. A.A.Vorob'ev.
Zh. tekh. Fiz., Vol. 26, No. 2, 330-2 (1956). In Russian.

Discussion of recent literature on the relations and analogies between various types of breakdown, and their close relation to the lattice energy which is experimentally established, leads to the conclusion that a more unified or general theory of dielectrics must definitely consider the lattice energy as an important factor. Electrical Research Association

ELECTRIC CONDUCTION. CURRENTS 537.3

537.31 : 621.317.353

5851. LOW-FREQUENCY POWER SPECTRUM ANALYZER. T.E.Firle.
Rev. Sci. Instrum., Vol. 27, No. 3, 140-3 (March, 1956).

A system used to obtain power spectra of noise in semiconductors for the frequency range from 0.00006 to 0.02 c/s is described. This instrument, which could be used for the analysis of any very low frequency wave, shifts the frequencies into the audio range where they are analysed with an electronic audio-frequency wave analyser. The frequency shift is achieved by recording the low-frequency phenomenon on photographic film in the form of a variable-area recording. The film is played back at a greatly increased rate, modulating a photo-tube current which is fed into an analyser. Speed-up ratios, i.e., multiplications in frequency, of more than 500 000 times have been attained. A.

537.311.31

5852. CONTRIBUTION TO THE THEORY OF THE CONDUCTIVITY OF METALS AT LOW TEMPERATURES. B.Mühlschlegel.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 199-213 (1956). In German.

Deals with transport phenomena in the presence of an electric field (E) and a temperature gradient (grad T) by extending a method due to Koppe (Abstr. 5777/1952). In this approach the disturbed distribution function for electrons is characterized by the functions ξ and η which go over, in the absence of the field and the temperature gradient, into the usual Fermi surface energy and kT respectively. Both functions depend on the direction (θ, ϕ) in k-space and on E and grad T. The main difference between the results derived here and the usual ones appears to reside in the occurrence of a factor $1-\gamma^2$ which is, however, very nearly unity for most metals. P.T.Landsberg

537.311.31 : 539.234

5853. A STUDY OF THE SPECIFIC EFFECT OF A SUBSTRATE OF BISMUTH OXIDE ON THE CONDUCTIVITY OF VERY THIN FILMS OF CERTAIN METALS. S.-S.Min and S.Offret.
C. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2117-20 (April 23, 1956). In French.

The metals Al, Ag, Au, Cu, Pt were evaporated on to the substrate. For the granular films of Au an effect analogous to that reported previously (Abstr. 9645/1955) for thick films was observed. Very important for Ag and Au, this effect is practically nil for Pt, Cu and Al. An epitaxial mechanism is suggested. W.Bardsley

537.311.31 : 538.632

5854. TEMPERATURE DEPENDENCE OF THE HALL COEFFICIENTS IN SOME COPPER NICKEL ALLOYS. F.E.Allison and E.M.Pugh.
Phys. Rev., Vol. 102, No. 5, 1281-7 (June 1, 1956).

The two Hall coefficients and the resistivity of Cu–Ni alloys containing 80%, 70% and 60% Ni have been measured from 4°K to 400°K. These alloys were chosen because early measurements had indicated that conduction in the 3d bands of these ferromagnetic alloys could be neglected. The values of R_0^*, from precise Hall measurements at high fields, are in excellent agreement with the predictions of the band model that divides the conduction band into parallel and antiparallel bands. The data on all three alloys fit the predicted curve at temperatures below their Curie points and also fit the predicted Curie point anomaly due to $\partial M/\partial B \neq 0$ at high fields in this temperature region. The dependence of R_1^* upon resistivity is in agreement with the law $R_1^* = A\rho^n$. For 80% and 70% Ni the coefficient A and the exponent n agree with the values obtained for pure Ni. A significant departure from the pure Ni value is observed, however, in the 60% Ni alloy. Evidence is presented that indicates this law should be extrapolated through the temperature region above the Curie point where the alloys are paramagnetic. A.

537.311.31

5855. SCATTERING OF ELECTRONS FROM CLUSTERED VACANCIES IN COPPER. D.L.Dexter.
Phys. Rev., Vol. 103, No. 1, 107-10 (July 1, 1956).

The excess resistivity, ρ, and resistivity per unit stored energy, q, associated with dislocations, vacancies, and interstitials are briefly reviewed, and the same quantities are calculated for clustered vacancies. For clusters of more than one hundred vacancies, which seem to exist at room temperature in cold-worked or bombarded copper, q is larger by factors of about 3, 8 and several hundred than the corresponding ratios for vacancies, interstitials and dislocations. A.

537.311.31 : 537.531 : 535.343 : 539.11

BRILLOUIN ZONES, ELECTRICAL CONDUCTIVITY OF METALS, AND X-RAY K ABSORPTION SPECTRA. See Abstr. 5263

537.311.33

5856. THEORETICAL STUDY OF THE CURRENT–VOLTAGE CHARACTERISTICS OF A P-I-P SEMICONDUCTOR STRUCTURE, TAKING THE IONIZATION OF THE CENTRAL REGION BY THE CARRIERS INTO ACCOUNT. A.Leblond.
C. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1856-9 (April 9, 1956). In French.

The current and field equations for p-i-p junctions are given; above a certain current their resistance becomes negative, the magnitude of the negative resistance decreasing with increasing current. J.Franks

537.311.33 : 538.632

5857. A SIMPLE APPARATUS FOR RECORDING THE VARIATION OF HALL COEFFICIENT WITH TEMPERATURE. E.H.Putley.
J. sci. Instrum., Vol. 33, No. 4, 164 (April, 1956).

The apparatus described can be used to record automatically the variation of Hall coefficient with temperature of such semiconductors as indium antimonide, the range from liquid air to room temperature being covered in about twenty minutes. C.A.Hogarth

537.311.33 : 548.7

5858. IONIZATION INTERACTION BETWEEN IMPURITIES IN SEMICONDUCTORS AND INSULATORS. R.L.Longini and R.F.Greene.
Phys. Rev., Vol. 102, No. 4, 992-9 (May 15, 1956).

It is known that the free energy of an imperfect semiconductor or insulator crystal contains terms which arise from the ionizability of these imperfections and which represent chemical interactions between imperfections of the same and different kinds. It is shown that these ionization terms, which involve the Fermi level and the parameters of the energy band model, explain the systematic differences between n- and p-type semiconductors in lattice vacancy concentration, in substitutional atom diffusion coefficients, and in amphoteric impurity behaviour. The ionization terms also explain the variation of solid-liquid impurity distribution coefficients with the crystal growth rate of certain semiconductors, and also the well-known "charge balance" effect in insulators.

537.311.

5859. THEORY OF TRANSPORT EFFECTS IN SEMICONDUCTORS: THE NERNST COEFFICIENT, AND ITS RELATION TO THERMOELECTRIC POWER. P.J.Price.
Phys. Rev., Vol. 102, No. 5, 1245-51 (June 1, 1956).

A general expression for the Nernst coefficient, in terms of phenomenological parameters of the band transport equations, is derived for a two-band semiconductor for which Boltzmann statistics may be applied to the carrier distributions. The expression reduces to that given by Putley when the assumptions are made. The information obtainable from experimental values of the Nernst coefficient is discussed in the light of the expression derived in the paper. Also discussed how this information might be supplemented from experimental values of the thermoelectric power. An expression for the latter, in terms of the phenomenological band transport parameters, is given. It reduces to that given by Johnson and Lark–Horovitz, when their assumptions are made. It is pointed out that the phonon drag effect effect should cause an anomaly in the Nernst coefficient corresponding to that in the thermoelectric power, and an estimate of the former anomaly is made.

537.311.33 : 538.

5860. GALVANOMAGNETIC EFFECTS IN A SEMICONDUCTOR WITH TWO SETS OF SPHEROIDAL ENERGY SURFACES. M.Glicksman.
Phys. Rev., Vol. 102, No. 6, 1496-501 (June 15, 1956).

The conductivity, Hall coefficient, and low-field magnetoresistance are calculated for a semiconductor with conduction in two sets of spheroids, one set oriented along [100] directions, the other along [111] directions in reciprocal lattice space. These calculations are used in an analysis of experimental data on alloys of 12-17% silicon in germanium. A good fit to the data is obtained assuming such a conduction band, with the shape of the [111] spheroids similar to that found in germanium and the shape of the [100] spheroids like those in silicon. Some interband scattering is introduced to give the observed mobility variation with composition. The calculated energy separations of the [111] and the [100] minima depend strongly on the scattering assumed.

537.311.

5861. STUDY OF 1/f NOISE IN SEMICONDUCTOR FILAMENTS. L.Bess.
Phys. Rev., Vol. 103, No. 1, 72-82 (July 1, 1956).

A theory is devised for the generation of 1/f noise in semiconductor filaments, involving the diffusion of impurity atoms along the surface of the sample and along edge dislocations within the bulk. A set of six experiments is described which tends to corroborate this theory.

537.311.

5862. THE EFFECT OF FIELD EMISSION ON THE BEHAVIOUR OF SEMICONDUCTOR CONTACTS. R.Stratton.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 491-2 (April, 1956).

The work of Sillars (Abstr. 2093/1956) is extended to include arbitrary gap widths and fields which may be a function of the radial displacement from the centre of a point contact. W.Bardsley

537.311.33

33. ON THE DETERMINATION OF VOLUME AND SUR-
.CE RECOMBINATION EFFECTS FOR CHARGE CARRIERS
SEMICONDUCTORS. W.Heywang and M.Zerbst.
Naturforsch., Vol. 11a, No. 3, 256-7 (1956). In German.

Means of determining the bulk lifetime τ_V and surface combination velocity s from experiments on the decay of otoconductivity are described. Typical results for τ_V and s e presented. C.A.Hogarth

537.311.33

64. RESISTANCE OF A METAL—SEMICONDUCTOR
ONTACT FOR LARGE CONTACT POTENTIAL DIFFER-
ICES. N.A.Gozhenko and Yu.M.Altaĭskiĭ.
. éksper. teor. Fiz., Vol. 30, No. 2, 401-2 (1956). In ssian.

The barrier resistance for contacts to Cu_2O was found to ry with the degree of occupation of surface levels as affected absorption of vapour (water, acetone, etc.). The type of riation appeared to depend on whether the c.p.d. metal—Cu_2O s small (Au, Cu) or large (Zn, Al), a transition being ob-rved near c.p.d. = 0.50 V. The effects were interpreted in ms of a lowering of the impurity level near the surface, e transition being ascribed to its crossing the Fermi level. C.H.L.Goodman

537.311.33

65. ON THE ELECTRICAL PROPERTIES OF BICRYS-
ALS. H.F.Mataré.
Phys., Vol. 145, No. 2, 206-34 (1956). In German.

The grain boundary model usually assumed for cubic lat-ces is discussed, and the growth of bicrystals containing a nall-angle boundary along the growth direction is described. -ray and optical data are presented for bicrystals of Si and e. The use of the tilt-boundary region in transistor assemb-es is described and an analysis of hole and electron flow ross and along the boundary is presented. C.A.Hogarth

537.311.33 : 537.525.8

66. THE EFFECT OF A GLOW DISCHARGE ON THE
ONDUCTIVITY OF CADMIUM SULPHIDE SINGLE CRYSTALS
ND THE FORMATION OF OHMIC CONTACTS.
Fassbender.
Phys., Vol. 145, No. 3, 301-18 (1956). In German.

The effects of a glow discharge, run in various gases ressure ~0.2 mm Hg), on single crystals of CdS, are de-ribed. Dark currents and photoconductivities were meas-ed, as a function of various discharge parameters. The sults are shown, and discussed in terms of changes in rface layers of the crystals, and energy-level schemes erein. J.D.Craggs

537.311.33

67. ELECTRICAL MEASUREMENTS ON TYPE IIb DIA-
ONDS. H.B.Dyer and P.T.Wedepohl.
oc. Phys. Soc. B, Vol. 69, Pt 3, 410-12 (March, 1956).

Reports measurements on semiconducting diamonds. roperties: p-type from Hall and rectification measurements ainst tungsten whisker; 60 : 1 rectification ratio at 1 V; eys Ohm's law up to 4 V applied; 8 x 10^{13} holes per cm^3; nductivity is proportional to infrared band strength for rticular diamonds; the "apparent" activation energy below 0°K is about 0.77 eV. C.A.Hogarth

537.311.33 : 538.63

68. WEAK FIELD MAGNETORESISTANCE OF n-TYPE
ERMANIUM. C.Goldberg and R.E.Davis.
ys. Rev., Vol. 102, No. 5, 1254-7 (June 1, 1956).

The magnetoresistance of 11 ohm-cm n-type germanium s been measured from 77°K to 320°K. Analysis of the sults indicates that the data are consistent with the model ich assumes that the energy surfaces are (111) ellipsoids. e most consistent analysis indicates that the mass ratio is proximately constant (about 11.9) in this temperature range but that the scattering mechanism is temperature-dependent. The relaxation time may be approximated by $\tau = l\epsilon^s$, where s = s(T). A.

537.311.33

5869. SLOW SURFACE REACTION ON GERMANIUM.
S.R.Morrison.
Phys. Rev., Vol. 102, No. 5, 1297-301 (June 1, 1956).

An experimental study of the long decay time levels has shown that the reaction between the levels and the bulk germanium depends on the number of carriers in the germanium, on the oxygen pressure, and exponentially on the temperature. It is therefore suggested that the rate-limiting process is electron transfer over a surface barrier. A simplified model, based on this mechanism, yields adequate agreement with the present results and also with those obtained by Kingston. A.

537.311.33 : 548.7

5870. HOLE TRAPPING IN GERMANIUM BOMBARDED BY
HIGH-ENERGY ELECTRONS. R.G.Shulman.
Phys. Rev., Vol. 102, No. 6, 1451-5 (June 15, 1956).

On the basis of an investigation of n-type germanium bombarded with high-energy electrons, it is concluded that a particular set of temporary hole traps is created by the bombardment. The bombardment centres which remained in the samples at room temperature were measured by resistivity changes and found to agree with the densities of traps. Different samples with trap densities varying from 5 x $10^{12}/cm^3$ to 5 x 10^{14} cm^3 were studied. An analysis of the trapping kinetics, essentially similar to those previously reported by Haynes and Hornbeck and by Fan, permits the energy of the traps to be determined as 0.28 eV above the valence band while the cross-section for capture is 6 x 10^{-15} cm^2 at 200°K. A.

537.311.33 : 548.7

5871. COPPER IN GERMANIUM: RECOMBINATION
CENTER AND TRAPPING CENTER. R.G.Shulman and
B.J.Wyluda.
Phys. Rev., Vol. 102, No. 6, 1455-7 (June 15, 1956).

The time-dependent photoconductivity of copper-doped n-type and p-type germanium bridges has been measured between 130°K and 293°K. Temporary hole traps were found in the n-type samples at the lower temperatures but no traps were observed in the p-type. Trap concentrations agreed with the density of copper atoms to within a factor of two and were at least 100 times higher than undoped crystals. The trappings levels are 0.2 eV above the valence band; the capture cross-section for holes, σ_p, is 10^{-16} cm^{-2} and independent of temperature while the capture cross-section for electrons, σ_n, is temperature-dependent with an activation energy greater than 0.1 eV. As a result of this temperature dependence of σ_n, the 0.2 eV copper level changes from a recombination centre at room temperature to a hole trap at lower temperatures. A.

537.311.33 : 538.63

5872. GALVANOMAGNETIC THEORY FOR ELECTRONS IN
GERMANIUM AND SILICON: MAGNETORESISTANCE IN THE
HIGH-FIELD SATURATION LIMIT. L.Gold and L.M.Roth.
Phys. Rev., Vol. 103, No. 1, 61-6 (July 1, 1956).

For constant scattering time τ and ellipsoidal energy surfaces, the Boltzmann transport equation reduces to a phenomenological equation of motion for electrons from which a conductivity tensor is derived. The calculations for germanium and silicon differ in the orientation of the ellipsoids. The resistivity tensor is evaluated in the saturation limit, and explicit expressions for the angular dependence of the magnetoresistance are elaborated for certain high-symmetry combinations. The theoretical findings are in qualitative agreement with experiment, thus providing confirmation of the 4- or 8-ellipsoid [111] and the 3- or 6-ellipsoid [100] models of the energy surfaces in n germanium and n silicon, respectively. Essential agreement with energy-dependent τ theory is also established. A.

537.311.33

5873. TIME DEPENDENT CHANGES OF SURFACE LIFE-TIME IN GERMANIUM IN THE PRESENCE OF ELECTRIC FIELDS. J.D.Nixon and P.C.Banbury.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 487-8 (April, 1956).

The change in conductance of an illuminated specimen is measured for applied fields up to 3×10^4 V/cm. This extension of recent work (Abstr. 7048/1955) shows that the application of a field produced a sudden conductance change, which decayed to a small value in about 200 seconds. Removal of the field produced a similar effect but opposite in sign. The surface recombination velocity is plotted as a function of field.
W.Bardsley

537.311.33

5874. INFLUENCE OF HEAT TREATMENT ON THE LIFE OF THE SUBSIDIARY CURRENT CARRIERS IN GERMANIUM (KINETICS OF THE FORMATION OF DEFECTS DURING HEAT TREATMENT). T.V.Mashovets and S.M.Ryvkin.
Zh. tekh. Fiz., Vol. 25, No. 9, 1530-43 (1955). In Russian.

The effect of thermal treatment at comparatively "low" temperatures (400-500°C.) on the life of the subsidiary current carriers in germanium is that the life decreases with rising temperature and duration of the treatment. The cause is the occurrence of defects acting as recombination centres. Investigation of the kinetics of the defect formation process yielded data on the energy structure of the defects.
Electrical Research Association

537.311.33

5875. ENERGY DISTRIBUTION OF THE ELECTRONS IN THE EXTERNAL PHOTO-EFFECT OF GERMANIUM CONTAINING ADMIXTURES. A.N.Arsen'eva-Geĭl'.
Zh. tekh. Fiz., Vol. 25, No. 9, 1544-6 (1955). In Russian.

The energy distribution of the photo-electrons indicates that they must come from two different energy ranges because the distribution curve has a sharp bend. This grouping is apparently due to the presence of donor and acceptor-type admixtures. It is possible that the electrons are also excited from superficial states, the density of which is high enough, if admixtures $\sim 10^{19}/cm^3$. The small value of the photoelectric work function 4 eV must also be due to admixture electrons.
Electrical Research Association

537.311.33

5876. TEMPERATURE VARIATIONS OF THE WORK FUNCTION OF n AND p GERMANIUM. A.R.Shul'man and A.N.Pisarevskiĭ.
Zh. tekh. Fiz., Vol. 25, No. 9, 1547-55 (1955). In Russian.

Temperature relations of ϕ are different for n and p germanium. The experimental relations seem to contradict A.N.Smith's findings, but his experiments excluded the temperature range in which variations of ϕ must be expected; also, there might have been differences of state and structure of the specimens investigated. The distance δ between the level of the chemical potential and that of the source of photoelectrons has also different temperature relations.
Electrical Research Association

537.311.33

5877. INVESTIGATION OF THE RESISTANCE VARIATION OF GERMANIUM IN A MAGNETIC FIELD. V.I.Stafeev and V.M.Tuchkevich.
Zh. tekh. Fiz., Vol. 26, No. 2, 273-6 (1956). In Russian.

The characteristics $\Delta\rho/\rho_0 = f(H)_T$ are power functions with varying exponents. This applies to strong and weak fields. The field strength corresponding to a bend in curves on a double-logarithmic scale shifts with higher temperatures to stronger fields, this agreeing with theoretical expectations. The character of the function $\Delta\rho/\rho_0 = f(H)_T$, however, and particularly the variation of the exponent, is in contradiction to theory.
Electrical Research Association

537.311.33 : 621.314.7 : 621.315.5

5878. THE ELECTRON-VOLTAIC EFFECT IN GERMANIU AND SILICON P-N JUNCTIONS. P.Rappaport, J.J.Loferski and E.G.Linder.
RCA Rev., Vol. 17, No. 1, 100-28 (March, 1956).

The electron-voltaic effect is analysed to show how the properties of the semiconductor (energy gap, minority carrie diffusion length, surface recombination velocity and the temperature) and of the impinging electrons (average energy, density, maximum energy) affect the usefulness of the electro voltaic effect as a means of converting the energy of beta ray into electricity. Experiments on Ge and Si p-n junctions are described. It is shown that the maximum conversion efficienc using Si p-n junctions will probably not exceed about 5%. Measurements on such junctions show a maximum efficiency of 2.5%, with an open-circuit voltage of 0.35 V and short-circuit current of 20 μA under irradiation by 50 mc. of Sr^{90}-Y^{90}. With such a source, beta-particle multiplications of approx. 2.5×10^5 have been observed. These correspond to an averag cost in energy per electron-hole pair of about 4.2 eV in Si and 4.4 eV in Ge. Experiments with monoenergetic beta particles are also described. The effect of radiation damage is discussed.
A

537.311.3

5879. ON THE CONDUCTIVITY OF INDIUM ANTIMONIDE AT LOW TEMPERATURES. J.Bok.
C.R. Acad. Sci. (Paris), Vol. 242, No. 17, 2114-17 (April 23 1956). In French.

The study of the conductivity of a semiconductor at a temperature of 20°K gives evidence of three regions. As the current through the specimen increases, at first Ohm's law is seen to be obeyed, then there is a region where the field remains constant, then finally a region where the field increases rapidly. An interpretation of the second region is offered. Experiments to test this interpretation are propose
W.Bardsle

537.311.3

5880. ELECTRICAL CHARACTERISTICS OF InSb. D.N.Nasledov and A.Yu.Khalilov.
Zh. tekh. Fiz., Vol. 26, No. 1, 6-14 (1956). In Russian.

The electrical characteristics of indium antimonide with hole and electron conductivities were investigated, viz. the temperature relation of the electrical conductivity from 1.3 t 673°K, Hall effect up to 33 000 oersted and the variation of resistance in a magnetic field. The changes of sign of the Ha constant in a magnetic field at various temperatures were al observed.
Electrical Research Associatio

537.311.3

5881. ELECTRICAL CHARACTERISTICS OF InAs. D.N.Nasledov and A.Yu.Khalilov.
Zh. tekh. Fiz., Vol. 26, No. 2, 251-4 (1956). In Russian.

From 1.3°K to room temperature conductivity is temper ture-independent, i.e. of impurity-character. It then rises quickly with temperature. Hall effect was investigated at various temperatures. Carrier-concentration at room tempe ture $\sim 10^{17} cm^{-3}$. Temperature-relation of $\Delta\rho/\rho$ in a given magnetic field obtained. At 400°C and 20 000 oersted resistance increases fourfold. Carrier mobility increases at high temperatures up to $1.2 \times 10^5 cm^2/V.sec$. No exact interpretation is possible, but this corresponds to general effect of magnetic fields on resistance.
Electrical Research Associatio

537.311.3

5882. ELECTRICAL CONDUCTION IN MAGNESIUM STAN NIDE AT LOW TEMPERATURES. H.P.R.Frederikse, W.R.Hosler and D.E.Roberts.
Phys. Rev., Vol. 103, No. 1, 67-72 (July 1, 1956).

Measurements of conductivity, Hall effect, and magneto-resistance of magnesium stannide at temperatures between 2

d 80°K indicate that this compound shows an "anomalous" haviour similar to that observed in germanium and other niconductors. Results in the helium range suggest that the nduction takes place in a surface layer rather than in the k of the sample (impurity-band conduction). Values of the nsity of surface carriers and their mobility are consistent h this this theory. A.

537.311.33

3. THE ACTION OF IMPURITIES AND HEAT TREATNT ON THE ELECTRICAL PROPERTIES OF HIGHLY RIFIED TELLURIUM. H.Kronmüller, J.Jaumann and eiler.

Naturforsch., Vol. 11a, No. 3, 243-50 (1956). In German.

By sublimation of distilled material, Te, whose impurity centration was about 10^{14} cm^{-3}, was doped with As, Sb, Br, d Hall effect and conductivity measurements made over the ge −140 to 300°C, the results indicating p-type conduction ll cases. The Gp V elements were much more effective n the halogens. The intrinsic activation energy is found to 0.35 eV. C.A.Hogarth

537.311.33 : 538.632

4. HALL EFFECT IN GRAY TIN FILAMENTS. E.Kohnke and A.W.Ewald.

ys. Rev., Vol. 102, No. 6, 1481-6 (June 15, 1956).

Measurement in the temperature range from 70 to 270°K described. It is found that electron and hole mobilities en by the expressions $\mu_n = 3.02 \times 10^7 T^{-1.65}$ cm^2/volt sec and $= 2.18 \times 10^8 T^{-2.0}$ cm^2/volt sec combined with an impurity ncentration of 2.5×10^{17} cm^{-3} give a good fit to the conducity and Hall data for pure material in the range extending 0 degrees down from the highest measurement temperature. e intrinsic energy gap at absolute zero is 0.094 eV. If one sumes a temperature dependence of -5×10^{-5} eV/deg, the h-temperature value of the energy gap remains substanlly unaltered from that previously reported and the effective sses of charge carriers have the value 0.68 electron mas. Data for the lower temperature range indicate slight generacy and impurity scattering of charge carriers. Simicomputations and results are discussed for other samples ped with n-type impurities. In contradiction to the results n-type samples, p-type samples indicate mobility ratios ghtly higher than unity. There is no indication, however, of remely high mobility ratios such as those found in InSb. e field dependence of the Hall coefficient of p-type speci- ns shows a shift of the cross-over to higher temperatures h increasing magnetic field, qualitatively in agreement with tropic theory. A.

537.312.5 : 771.53

5. ON THE MECHANISM OF THE NEGATIVE EFFECT THE PHOTOELECTRIC CONDUCTION PROCESS OF LVER BROMIDE. K.Yamada and S.Oka.

turwissenschaften, Vol. 43, No. 8, 175 (1956). In German.

The initial fall of conductivity in illuminated AgBr crystals y be prevented by treatment with oxidizing agents, and re- ored by other chemical reagents or by storage in the dark. ese and other experiments suggest an explanation of the gative effect: surface specks of Ag are charged by capture photoelectrons, and then attract interstitial Ag ions, so vering the ionic conductivity; if this loss is larger than the in of electronic conductivity under illumination, a net fall conductivity will result. S.T.Henderson

537.312.5

6. PHOTOSENSITIZATION OF PbS FILMS. R.H.Harada d H.T.Minden.

ys. Rev., Vol. 102, No. 5, 1258-62 (June 1, 1956).

The effect of O_2 on the photoconductive response of evarated PbS films has been experimentally investigated. The rk conductance g, the photoconductance Δg, and the time nstant τ for the photoconductive response of PbS evaporated ns vary when the films are exposed to oxygen. Initially g decreases several orders of magnitude when an outgassed film is exposed to oxygen; it reaches a minimum and then increases. The thermoelectric power changes from negative to positive at the minimum in conductance. Δg and τ are given as a function of g. Δg decreases with increasing oxygenation, reaches a minimum near the minimum in g and then increases as g increases after the film becomes p-type; Δg/g is a maximum, however, near the minimum in g. On the other hand, τ increases steadily as the film changes from n- to p-type. These results are attributed to the effect of two oxygen surface states. A low-lying O^- state alters the Fermi level of the originally n-type film. The surface charge thus formed lowers the effective carrier mobility. A higher-energy $O^{-\,-}$ state, when empty, traps photoelectrons and hence enhances the hole photoconductivity. A.

537.312.5

5887. ON THE SPECTRAL DISTRIBUTION OF THE PHOTOEFFECT IN LEAD SULPHIDE. H.U.Pfeiffer.

Z. Naturforsch., Vol. 11a, No. 2, 164-5 (1956). In German.

A detailed description is given of the change in photoconduction response of evaporated lead sulphide layers during oxidation at atmospheric pressure. G.F.J.Garlick

537.312.5

5888. PHOTOELECTRIC CHARACTERISTICS OF SOME COMPOUNDS WITH THE STRUCTURE OF ZINC BLENDE. N.A.Goryunova, V.S.Grigor'eva, B.M.Konovalenko and S.M.Rÿvkin.

Zh. tekh. Fiz., Vol. 25, No. 10, 1675-82 (1955). In Russian.

All the compounds investigated, viz. Ga_2Se_3, Ga_2Te_3, Ga_2Te_3.ZnTe, Ga_2Te_3.3ZnTe, Ga_2Te_3.9ZnTe, β-Ga_2S_3, GaSe, GaTe, are semiconductors and are photosensitive. On transition from one substance to another of the same structural type the long-wave limit of the photoconductivity shifts in a regular way and, therefore, also the energy interval corresponding to the width of the prohibited zone. The ever more prevalent ionic character of the bond explains the phenomena. Electrical Research Association

537.312.5

5889. NON-ADDITIVITY OF SELENIUM PHOTOELEMENTS WITH BARRIER LAYER UNDER THE EFFECT OF AN EXTERNAL VOLTAGE. Z.A.Gol'dman.

Zh. tekh. Fiz., Vol. 25, No. 10, 1689-95 (1955). In Russian.

When a selenium photoelement is irradiated with $\lambda < 650$ mμ and simultaneously with long waves, the photocurrent may under favourable conditions become a multiple of the photo-current obtained under long-wave irradiation alone (non-additivity). The VA-characteristics of the photoelement show that the short waves remove the barrier layer and its resistance, so that the subsequent reduction of the resistance of the selenium due to the long waves results in the considerable increase of the photo-current observed.

Electrical Research Association

537.312.5

5890. ELECTRON-MICROSCOPIC INVESTIGATION OF THE STRUCTURE OF PHOTO-CATHODES SUBJECTED TO GAS DISCHARGES. A.I.Frimer, E.M.Belavtseva and A.M.Gerasimova.

Zh. tekh. Fiz., Vol. 26, No. 3, 549-52 (1956). In Russian.

537.312.62

5891. TWO-FLUID MODEL OF AN "ENERGY-GAP" SUPERCONDUCTOR. H.W.Lewis.

Phys. Rev., Vol. 102, No. 6, 1508-11 (June 15, 1956).

It is pointed out that an exponential specific heat law in a superconductor leads to a uniquely specified form of two-fluid model. The properties of this model are derived, and compared with the corresponding properties of the usual Gorter–Casimir model. A.

537.312.62

5892. INVESTIGATION OF THE SUPERCONDUCTIVITY OF HAFNIUM. R.A.Hein.
Phys. Rev., Vol. 102, No. 6, 1511-18 (June 15, 1956).

The magnetic susceptibility of two polycrystalline rods of hafnium (Hf I and Hf II) was observed from 4.22°K down to 0.08°K. The electrical resistance of these specimens was also observed from room temperatures down to 0.08°K. While the magnetic measurements indicated unambiguously that no superconducting transition occurred, the electrical resistance did, however, exhibit a decrease at approximately 0.19°K for Hf I and 0.28°K for Hf II. The resistance did not fall to zero but remained finite down to the lowest temperatures obtained. The temperature at which this decrease occurred was found to be sensitive to an externally applied magnetic field. Critical field data were obtained for Hf I which indicated a $(dH/dt)_T = T_c$ of 450 gauss/degree. Magnetic and electrical measurements obtained for one of the specimens, subsequent to an anneal, indicated no marked change in these measured quantities. Both these specimens had a stated purity of 98.92%. The magnetic susceptibility of a third specimen of hafnium was observed and a superconducting transition was noted at 0.173°K. This specimen was in the form of lathe turnings and was approximately 96% pure. A few critical field points were obtained which yield a value for $(dH/dT)_T = T_c$ of 130 gauss/degree. From a consideration of all the available data concerning the superconductivity of hafnium, it is felt that pure hafnium is probably not a superconductor down to a temperature of 0.08°K. A.

537.312.62

5893. "ACOUSTIC EXCITATIONS" IN SUPERCONDUCTORS. Yu.L.Klimontovich.
Zh. éksper. teor. Fiz., Vol. 28, No. 6, 754-6 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 602-4 (Nov., 1955).

The phenomenological theory of Ginzburg and Landau (Abstr. 1017/1952) is modified by introducing a term $i\hbar\partial\Psi/\partial t$ in the wave equation for the function Ψ. It is then found that solutions exist in which the density of superconducting electrons $|\Psi|^2$ exhibits phonon-like excitations. It is suggested that these are responsible for the T^3 specific-heat variation of superconductors. R.G.Chambers

537.312.9

5894. RESISTIVITY INCREASE IN WATER-QUENCHED GOLD. J.E.Bauerle, C.E.Klabunde and J.S.Koehler.
Phys. Rev., Vol. 102, No. 4, 1182 (May 15, 1956).

The increase in resistivity of gold wires quenched from a temperature T (920° to 1220°K) to room temperature was found to vary as $e^{-E_F/kT}$ where E_F, the energy of formation of the defects responsible for the increase, was 1.02 ± 0.06 eV. The resistivity measurements were made at liquid nitrogen temperature. Most of the increase in resistance disappeared on annealing at room temperature, and isothermal annealing measurements gave an energy of motion $E_M = 0.66 \pm 0.06$ for the defects. Assuming the defects to be vacancies, $E_F + E_M$, the activation energy for self-diffusion in gold agrees well with previous measurements by other means. M.R.Hopkins

537.32

5895. VACUUM STUDY OF THE THERMO-E.M.F. OF VERY THIN FILMS OF ALUMINIUM. F.Savornin.
C. R. Acad. Sci. (Paris), Vol. 242, No. 16, 1969-71 (April 16, 1956). In French.

A special apparatus for the study of thin Al films in situ is described together with some preliminary observations. C.A.Hogarth

537.323 : 538.632

5896. HALL COEFFICIENT AND THERMOELECTRIC POWER OF THORIUM METAL. J.H.Bodine, Jr.
Phys. Rev., Vol. 102, No. 6, 1459 (June 15, 1956).

The Hall coefficient of two samples of thorium metal was measured at room temperature in magnetic fields of the orde of 4000 gauss, and an average value of -1.2×10^{-11} volt-cm/ abampere gauss obtained. The voltage of a thorium–platinum thermocouple in the temperature range 400°C to 1100°C is al reported. A

537.36

5897. DERIVATION OF AN EXPRESSION FOR THE EVALU ATION OF EXACT ζ POTENTIAL OF TWO PORES OF DIFFERENT AVERAGE DIAMETERS CONNECTED IN SERIES. B.N.Ghosh.
Naturwissenschaften, Vol. 43, No. 5, 104 (1956).

The electro-osmotic behaviour of two pores of different cross-sectional areas connected in series is controlled mainl by the pore of smaller diameter. For exact determination of ζ the diaphragm should consist of layers whose volume ratios differ little from one another. J.H.Mason

ELECTRIC DISCHARGES 537.52

537.523.3

5898. CALCULATION OF A.C. CORONA CHARACTERISTICS. G.N.Aleksandrov.
Zh. tekh. Fiz., Vol. 25, No. 10, 1804-16 (1955). In Russian.

The main contribution to corona losses is the energy lost in inelastic collisions of electrons and ions with gas molecule in the field of the corona space, whereas energy spent on ioni ation and radiation is negligible. A theoretical investigation and calculation of the corona characteristics must therefore b based mainly on that of the ion movements in the corona space The results of experimental investigations confirm the correc ness of the method qualitatively and, if initial conditions are correctly chosen, quantitatively. Electrical Research Association

537.523.5

5899. THE THEORY OF THE ANODE FALL. IV. THE ANODE FALL OF HIGH-CURRENT CARBON ARCS IN AIR. W.Bez and K.H.Höcker.
Z.Naturforsch., Vol. 11a, No. 2, 118-23 (1956). In German.

For Pt III, see Abstr. 1264 (1956). A detailed quantitative treatment of the anode fall region, embracing the study of temperature (ion- and electron-) variations in the anode fall, current densities, ion velocities etc. The fall region thickness is $\sim 10^{-3}$ cm, and graphs of the spatial variations of the above quantities are given. A primarily theoretical approach is taken. J.D.Cragg

537.523.5

5900. THE THEORY OF THE ANODE FALL. V. THE HISSING OF HOMOGENEOUS CARBON HIGH-CURRENT ARC IN AIR. W.Bez and K.H.Höcker.
Z. Naturforsch., Vol. 11a, No. 3, 192-6 (1956). In German.

Gives a theoretical discussion of arc hissing in terms of the instability effects in anode fall regions, in which magnetic forces are important. Experimental data are given for arcs carrying currents up to 100 A (frequencies of hissing up to $\sim$ 2000 c/s). J.D.Craggs

537.525

5901. THEORY OF THE STRATIFIED POSITIVE COLUMN. I.M.Chapnik.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 4, 529-32 (1956). In Russian.

Author considers the system of non-linear equations des cribing longitudinal plasma oscillations from which formulae relating oscillation period and damping with the discharge par meters are derived. The system of equations, suggested by Granovskiĭ, comprises expressions of electron balance, longi tudinal and radial electron velocities, ionization, energy

alance of electron gas, ion balance, longitudinal and radial on velocities, Poisson's equation and the equation of the radial ield component. Electrical Research Association

537.525

5902. ON THE CONTROLLING FACTOR OF PLASMA OSCILLATION PROPERTIES AND ON THE INFLUENCE OF GAS ATOMS ON THESE PROPERTIES. I.P.Basarov.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 426 (1956). In Russian.

The author draws attention to certain errors and inconsistencies contained in a previous paper (I.P. Basarov, Zh. éksper. teor. Fiz., Vol. 21, 711, 1951), and concludes that good agreement could not be expected between the experimental evidence concerning the influence of gas atoms on plasma oscillations and his theory owing to the inconsistency of assumptions made H.Motz

537.525.3 : 537.525.72 : 537.525.8

5903. STUDIES OF JOSHI EFFECT IN NEON WITH NON-DEGASSED AND DEGASSED DISCHARGE TUBES. V.Subrahmanyam.
Naturwissenschaften, Vol. 43, No. 8, 176-7 (1956).

Compares values of the Joshi effect for external electrode a.c. corona tubes filled with neon (3.22 mm Hg pressure). The effect of degassing is to reduce the influence of the external irradiation. J.D.Craggs

537.525.4

5904. THE STRIKING OF ELECTRICAL GASEOUS DISCHARGES IN HOMOGENEOUS A.C. FIELDS. W.Fucks, L.Graf, G.Mues and H.G.Müller.
Z. Phys., Vol. 145, No. 1, 1-19 (1956). In German.

A detailed study of breakdown of a gaseous dielectric (hydrogen) for applied voltages of widely varying frequencies (the range covered was from 50 to 2×10^8 c/s). Rogowski electrodes were used. Detailed experimental results are given, with a full discussion, and a comparison with previous relevant work. Gas pressures varied from 2 to 8 mm Hg. J.D.Craggs

537.525.5 : 537.525.8 : 537.562

5905. THE CHARACTERISTIC SIZE OF THE PLASMA OF A LOW PRESSURE MERCURY DISCHARGE WITH SEVERAL ELECTRON GROUPS. W.H.Schneider.
Acta phys. Austriaca, Vol. 10, No. 1-2, 54-65 (1956). In German.

Describes probe studies with 25-350 mA discharges (30-150 V discharge voltage) at Hg condensation temperature varying from −20 to +34° C (up to ~5 mm Hg vapour pressure). Besides the "primary" electrons, two Maxwellian groups were found. Spatial variations of discharge parameters are discussed in relation to the "characteristic size" of the discharge. Data on electron densities etc., in various conditions are given. J.D.Craggs

537.525.5 : 537.525.8

5906. AMBIPOLAR DIFFUSION AND FORMATION OF NEGATIVE IONS IN DECAYING PLASMAS IN OXYGEN. E.Schulz-Du Bois.
Z. Phys., Vol. 145, No. 3, 269-78 (1956). In German.

Discusses the measurement of ambipolar diffusion processes in decaying oxygen discharge plasmas, using microwave techniques and pressures ~ 1-5 mm Hg. Reference is made to Seeliger's H and T modes in which respectively O^+ and O_2^+ ions are predominant. Negative ions are formed in the T mode, and are there ascribed to a reaction involving O_3. Curves relating electron densities with time and diffusion coefficient data etc. are shown graphically and discussed in detail. J.D.Craggs.

537.525.5

5907. ON THE BEHAVIOUR OF A.C. ARCS IN VACUO. G.Müller.
Z.angew. Phys., Vol. 8, No. 5, 234-7 (1956). In German.

An experimental study of the physical processes occurring in the opening of contacts (cold electrodes) at speeds ~1.2 m/sec. The pressure range was 10^{-5}-10^{-3} mm Hg. Rates of change of current were $\sim 5.8 \times 10^6$ A/sec. Phenomena taking place after current zero were studied. Oscillograms of current-time and voltage-time variations are shown. J.D.Craggs

537.525.5

5908. THE POSITIVE ION CURRENT ON THE ELECTRODES OF A VACUUM ARC. O.B.Firsov.
Zh. tekh. Fiz., Vol. 26, No. 2, 445-7 (1956). In Russian.

A universal relation is obtained between the density of the positive ion current on the electrodes, the electron temperature and their concentration in the region of the potential maximum in the plasma of a vacuum-arc.
Electrical Research Association

537.525.8

5909. A METHOD OF DETERMINING THE CATHODE FALLS IN GLOW DISCHARGES. K.Rademacher and K.Wojaczek.
Naturwissenschaften, Vol. 43, No. 4, 78 (1956). In German.

Describes briefly how the cathode fall in a low pressure glow discharge (a) may be found by immersing the cathode in the plasma of another discharge (b) passing across the first discharge (a). The current through (b) is varied (0 - 6 A) and the effect on the voltage across (a) noted. From this curve the cathode fall is determined. Results are shown for a 1.5 mm Hg A discharge (10-40 in mA). J.D.Craggs

537.528 : 621.315.615

5910. SOME RELATIONSHIPS OF THE PHENOMENA OF THE ELECTRICAL EROSION OF METALS IN A L.V. DISCHARGE IN A LIQUID. I.G.Nekrashevich and S.P.Mitkevich.
Zh. tekh. Fiz., Vol. 26, No. 1, 90-5 (1956). In Russian.

The erosion of the electrodes in a l.v. capacitor discharge in transformer oil was investigated. The weights of eroded electrode material were determined for Pb, Zn, Cu, Co, Ni, Fe, Al, Cr and W electrodes in various combinations. An approximate quantitative relationship for the erosion in discharges between electrodes of the same materials was found. A qualitative interpretation of the observed relationships of erosion between electrodes of different materials is presented.
Electrical Research Association

X-RAYS 537.531

537.531 : 535.33

5911. X-RAY SPECTRUM OF PLUTONIUM AND ENERGY LEVELS OF TRANSURANIAN ELEMENTS. Y.Cauchois.
J. Phys. Radium, Vol. 16, No. 12, 81S - 83S (Dec., 1955). In French.

Emission and absorption spectra have been obtained. Some systematic deviations from Moseley's law are noted.
A.R.Stokes

537.531 : 535.43

5912. SMALL ANGLE X-RAY SCATTERING. R.D.Dragsdorf.
J. appl. Phys., Vol. 27, No. 6, 620-6 (June, 1956).

Colloidal silica of 30, 20, 10, and 5% concentration by weight was used to produce small-angle scattering. The resulting scattering showed plateaus which varied in angular position with concentration in the very small angle portion and then showed an approximation to the single particle scattering in the larger small angle region. This scattering from individual scattering centres followed that predicted by Debye. Aver-

age distances of separation of randomly spaced particles as determined from the particle-to-particle scattering plateaus checked those calculated from the concentrations. In addition, scattering from various sized particles ranging from diameters of 100 to 500 000 A were measured. Two theories, a refraction and reflection or ray theory and a diffraction or wave theory, have been applied to the analysis of this scattering. A comparison of the particle sizes as obtained using these two theories with the particle size as obtained by means other than X-ray scattering shows that for the larger particles, geometrical optics can be used satisfactorily; while for the small particles the diffraction theory gives the correct scattering relation. Particle size measurements were made on both wetted (colloidal) and dried samples. A.

537.531 : 535.33

5913. STUDIES ON THE "TECHNICAL" CONTINUOUS SPECTRUM OF X-RAYS. III. UNIVERSAL FORMULA FOR MASS IONIZATION COEFFICIENTS, i/ρ, OF X- AND γ-RAYS. H.Tellez-Plasencia.
J. Phys. Radium, Vol. 17, No. 3, 32 A - 34 A (March Suppl., 1956). In French.

For Pt II see Abstr. 1278 (1956). Continuation of previous work (see also Abstr. 6830/1954). An easily derivable formula for the coefficient defining the energy of electrons liberated by the absorption of X- and γ-rays. A list of values is given. C.G.Morgan

537.531 : 535.33

5914. SCINTILLATION SPECTROMETRY OF SOFT X-RAYS. W.Kolb.
Naturwissenschaften, Vol. 43, No. 3, 53-4 (1956). In German.

A NaI—Tl crystal is used in a scintillation counter spectrometer to analyse the fluorescence X-rays of materials. Discrepancies are found between the spectrum for lead fluorescence and that determined by Ehrlich (Abstr. 4730/1955) partly attributable to the use of hard lead (Pb—Sb) by the latter. G.F.J.Garlick

537.531 : 778.333 : 535.371.07

THE SPECTRAL QUANTUM- AND ENERGY-EFFICIENCY OF CALCIUM TUNGSTATE X-RAY INTENSIFYING SCREENS. See Abstr. 5016

CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533.2 : 537.58

5915. THERMIONIC EMISSION, FIELD EMISSION, AND THE TRANSITION REGION. E.L.Murphy and R.H.Good, Jr.
Phys. Rev., Vol. 102, No. 6, 1464-73 (June 15, 1956).

Although the theories of thermionic and field emission of electrons from metals are very well understood, the two types of emission have usually been studied separately by first specifying the range of temperature and field and then constructing the appropriate expression for the current. In this paper the emission is treated from a unified point of view in order to establish the ranges of temperature and field for the two types of emission and to investigate the current in the region intermediate between thermionic and field emission. A general expression for the emitted current as a function of field, temperature, and work function is set up in the form of a definite integral. Each type of emission is then associated with a technique for approximating the integral and with a characteristic dependence on the three parameters. An approximation for low fields and high temperatures leads to an extension of the Richardson—Schottky formula for thermionic emission. The values of temperature and field for which it applies are established by considering the validity of the approximation. An analogous treatment of the integral, for high fields and low temperatures, gives an extension of the Fowler—Nordheim formula for field emission, and establishes the region of temperature and field in which it applies. Also another approximate method for evaluating the integral is given which leads to a new type of dependence of the emitted current on temperature and field and which applies in a narrow region of temperature and field intermediate between the field and thermionic emission regions. A.

537.533.2

5916. THE POSSIBLE OCCURRENCE OF EXCITON-ENHANCED SECONDARY EMISSION. A.J.Dekker.
Physica, Vol. 22, No. 5, 361-6 (May, 1956).

A theoretical study is made of the possible occurrence of exciton-enhanced secondary emission in insulators containing donor levels. It is assumed that the primary beam produces, besides secondary electrons, excitons; the latter may ionize donors and thereby enhance the secondary yield. The discussion is limited to high primary energies, so that the range of primaries is large compared to the diffusion length of the excitons. It is concluded that the enhancement may be considerable if the destruction of excitons at the surface is not too large. A.

537.533.2

5917. ELECTRON EMISSION DURING CHANGES OF STATE F.Futschik, K.Lintner and E.Schmid.
Z. Phys., Vol. 145, No. 1, 48-53 (1956). In German.

Kramer has reported electron emission from Wood's metal as it cools from the liquid phase through the solidification point. Counter studies were made on the binary Pb—Sn system and the emission correlated with the phase diagram. The authors propose that the technique be used in the investigation of state changes. A.H.W.Beck

537.533.3

5918. PLANE ELECTROSTATIC FIELDS FOR WHICH RIGOROUS CALCULATION OF ELECTRON TRAJECTORIES IS POSSIBLE. H.Grümm.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 269-74 (1956). In German.

Only very few field distributions are known for which particle trajectories can be rigorously calculated. The problem is now attacked systematically in the most general terms, starting from a result of Staeckel (1893) on the conditions for separability of the Hamilton—Jacobi equation. The necessary conditions are more fully formulated for the case of plane fields (electron prisms and cylindrical lenses) and explicit expressions given for the types of field which are found to satisfy them. Among them are the special cases of an electrostatic cylindrical lens, an immersion cylindrical lens and a deflection system. V.E.Cosslett

537.533.3

5919. ROTATIONALLY SYMMETRICAL ELECTROSTATIC FIELDS FOR WHICH RIGOROUS CALCULATION OF ELECTRON TRAJECTORIES IS POSSIBLE. H.Grümm.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 275-80 (1956). In German.

The method developed in the preceding paper (preceding abstract) is extended to fields of rotational symmetry, as encountered in practical electron lenses. Explicit expressions are given, in a number of coordinate systems, for the fields which satisfy the necessary conditions. These fields will be investigated in more detail in a subsequent paper. V.E.Cosslett

537.533.3

5920. ELECTRON OPTICS OF CYLINDRICAL SYSTEMS WITH A PLANE OF SYMMETRY. II. ABERRATIONS. M.Laudet.
J. Phys. Radium, Vol. 16, No. 12, 908-16 (Dec., 1955). In French.

The first-order treatment of electron trajectories in Pt I (Abstr. 4721/1955) is extended to derive expressions for the coefficients of the various aberrations. R.Reed

537.533.3

5921. NOTE ON THE USE OF POINT CATHODES IN ELECTRON OPTICS. Y.Sakaki and G.Möllenstedt.
Optik, Vol. 13, No. 5, 193-200 (1956). In German.

The point cathode developed by Müller and Hibi emits electrons from an effective area of only a micron or so in diameter. The present authors have improved the technique for making such cathodes and incorporated them into an electron microscope. With such a small electron source, multi-fringe Fresnel diffraction patterns can readily be obtained without the use of auxiliary lenses or apertures.
A.E.I. Research Laboratory

537.533.3

5922. OBSERVATIONS AND MEASUREMENTS ON BI-PRISM INTERFERENCE USING ELECTRON-WAVES. G.Möllenstedt and H.Düker.
Z. Phys., Vol. 145, No. 3, 377-96 (1956). In German.

An electron-optical bi-prism is designed by means of a fine quartz thread between two separated plates on which a potential is applied. A narrow electron beam is used. Diffraction patterns can be obtained from the thin thread. The separation of the fringes at the edges depends upon the applied potential, and the diffraction fringes can be brought together, at which point ordinary Fresnel fringes appear within the shadow. There is exact analogy between the effects obtained with the electron waves and with light. Only voltages of a few volts are required on the bi-prism in order to produce these effects. The coherence length is determined for the electron waves. S.Tolansky

537.533.3 : 537.531

ELECTRON OPTICS OF X-RAY TUBES AND THE DESIGN OF UNBIASED SHARPLY-FOCUSING CATHODES.
See Abstr. 5131

537.533.331

5923. A VARIABLE ELECTROSTATIC FOUR-ELECTRODE PROJECTOR LENS. O.Rang and W.Weitsch.
Optik, Vol. 13, No. 5, 201-8 (1956). In German.

A four-electrode electrostatic projector lens is described. By varying the potential of each of two inner electrodes, a wide range of distortion-free magnification is obtained.
A.E.I. Research Laboratory

537.533.335

5924. CONSTRUCTION OF ELECTROMAGNETIC LENSES. P.Durandeau.
J. Phys. Radium, Vol. 17, No. 3, 18 A - 25 A (March Suppl., 1956). In French.

The axial field distribution in electromagnetic lenses is investigated for varying geometry of the pole pieces and the iron circuit. Optimum conditions for constructing short-focus lenses using high-speed (250 kV) electrons are given.
R.Reed

537.533.35

5925. IMAGES IN THE POINT-EMISSION ELECTRON MICROSCOPE DUE TO THE PRESENCE OF ORGANIC VAPOURS. E.Hörl and F.Stangler.
Acta phys. Austriaca, Vol. 10, No. 1-2, 1-7 (Jan., 1956). In German.

Residual organic vapours in the experimental apparatus give rise to the superposition of numerous spots of light on the normal emission image of the metal used for the point cathode. These spots are mostly of two or four-fold symmetry but after long operation of the tube a single brightly emitting region is formed, which has multiple sub-structure. The symmetrical spots are identified with those found by Müller (Abstr. 1101/1951) when copper phthalocyanine was introduced into the tube; he wrongly supposed them to be images of the molecular shape of this compound. It is suggested that they are small aggregates of metal atoms (similar to crystal nuclei) which are ejected under bombardment by organic ions and take up positions on the cathode point determined by its lattice structure, which is cubic for tungsten and molybdenum, the metals used in these experiments. V.E.Cosslett

537.533.35 : 621.385.833

5926. ELECTRON OPTICAL IMAGES WITH AN OBJECTIVE CONNECTED ACCORDING TO O.SCHERZER. G.Möllenstedt.
Optik, Vol. 13, No. 5, 209-15 (1956). In German.

The lens system proposed by Scherzer for correcting spherical aberration and constructed by Seeliger (Optik, Vol. 4, 258, 1948/49) has been improved further. The operating voltage has been increased from 25 to 40 kV and a magnetic condenser lens has been fitted. Up to now, a resolving power of 30 A has been attained but it is hoped by removing stray varying magnetic fields and other disturbing effects to attain a resolving power of 2 A. A.E.I. Research Laboratory

537.533.35

5927. A 100 kV TRANSMISSION ELECTRON MICROSCOPE FOR HIGH RESOLUTION AND SMALL FIELD. E.Ruska and O.Wolff.
Z. wiss. Mikr., Vol. 62, No. 8, 465-509 (Jan., 1956). In German.

A detailed description of the design and construction of the latest magnetic electron microscope from Siemens and Halske. The requirements for reaching a resolving power of 5—10 A are discussed and the technical means of realizing them described. The electron optical system (objective, intermediate lens and projector) provides ranges of magnification from 200 x up to 160 000 x at voltages of 40, 60, 80 and 100 kV. A two-stage condenser system allows the diameter of the illuminated area to be reduced to 2 microns, so as to limit its rise in temperature. The preparation of test specimens for high resolution is discussed as well as the conditions of thermal, mechanical and electrical stability required in viewing them. Using as measure of resolution the separability of neighbouring points and taking several pictures of the same field to rule out chance effects, a best resolution of 8 A is shown as compared with the theoretical limit of 2.8 A for the electron optical system as designed. V.E.Cosslett

537.533.7

5928. DISPERSION OF SECONDARY ELECTRONS SET IN MOTION BY 22 MeV X-RAYS. M.Tubiana, J.Dutreix and A.Dutreix.
J. Phys. Radium, Vol. 17, No. 3, 12 A - 17 A (March Suppl., 1956). In French.

A detailed theoretical and experimental examination of the motion of electrons in air, emitted from a screen bombarded by X-rays from a betatron. Aluminium and Plexiglass plates were used as screens. C.G.Morgan

537.533.71

5929. DEPENDENCE OF ELECTRON REFLECTION ON CONTAMINATION OF THE REFLECTING SURFACE. G.A.Harrower.
Phys. Rev., Vol. 102, No. 5, 1288-9 (June 1, 1956).

Measurements of the reflection of electrons from a tungsten target have been using electron energies from 3 to 1000 V. It was found that the reflection of electrons changed considerably during the formation of the first monolayer of contamination on the surface and thereafter remained constant. Whether the change was an increase or a decrease depended on the energy of the electrons. A.

537.533.74

5930. MULTIPLE ELASTIC SCATTERING IN ELECTRON DIFFRACTION BY MOLECULES. J.A.Hoerni.
Phys. Rev., Vol. 102, No. 6, 1530-3 (June 15, 1956).

Electron diffraction patterns from gas molecules con-

taining heavy atoms can be satisfactorily interpreted in terms of a pseudokinematical theory, in which rigorous atomic scattering amplitudes are used, but the Born approximation is retained for expressing the (molecular) interference between the various atomic contributions. It is shown that the correction brought by the second approximation of the pseudokinematical theory, involving multiple scattering on different atoms, is a smooth function of scattering angle and is therefore unimportant in the study of the oscillating interference term. A.

537.533.74

5931. MULTIPLE ELASTIC SCATTERING IN ELECTRON DIFFRACTION BY CRYSTALS. J.A.Hoerni.
Phys. Rev., Vol. 102, No. 6, 1534-42 (June 15, 1956).

In the case of electron diffraction by crystals containing heavy atoms, it is possible to improve the usual kinematical theory by formulating a pseudokinematical theory, which is expressed in terms of rigorous atomic scattering amplitudes rather than their Born-approximation values. A corresponding improvement can be made in the treatment of the problem by the dynamical theory, and consists in taking into account the coupling of a given diffracted beam with not only the incident beam (as is usually done in first approximation) but also with other diffracted beams. The pseudokinematical and dynamical theories are compared for very thin crystals and the conditions under which both give identical results are discussed. In particular, both predict a failure of Friedel's law in the case of acentric crystals. A.

537.533.75

5932. INVESTIGATION OF CHARACTERISTIC ENERGY LOSSES BY THE OPPOSING FIELD METHOD. G.Haberstroh.
Z. Phys., Vol. 145, No. 1, 20-43 (1956). In German.

A description of the apparatus for obtaining the energy spectra and angular distributions of fast electrons after traversing thin foils. Measurements were made with Al, Ag, Ge and Al_2O_3. The angular distribution and energy dependence of inelastically scattered electrons were obtained for Al and Ge foils. J.Franks

537.533.8

5933. DEPENDENCE OF SECONDARY ELECTRON EMISSION UPON ANGLE OF INCIDENCE OF 1.3-MeV PRIMARIES. R.A.Shatas, J.F.Marshall and M.A.Pomerantz.
Phys. Rev., Vol. 102, No. 3, 682-6 (May 1, 1956).

Utilizing a high-energy beam and targets sufficiently thin to permit the primary electrons to pass through with negligible scattering and energy loss, the secondary electron yield has been observed to vary with the angle of incidence of the primaries in accordance with the relationship $\delta(\theta) = \delta_0 \sec\theta$. This angular dependence is predicted theoretically on the basis of the single assumption that the secondary electrons can be treated as though they were produced with an isotropic velocity distribution. At large angles of incidence, the variation is slightly greater as a consequence of scattering effects which are larger in Ni than in an approximately equal thickness in $mg.cm^{-2}$ of Al. The experimentally observed equality of the yields in the forward and backward direction is consistent with the conclusion that the angular distribution of the secondaries is effectively isotropic. A.

537.533.8

5934. POLARIZATION OF BREMSSTRAHLEN. J.M.Dudley, F.W.Inman and R.W.Kenney.
Phys. Rev., Vol. 102, No. 3, 925-6 (May 1, 1956).

Deuteron photodisintegration detection was used to establish the polarization of the photons from 24 MeV electrons and the variation with emission angle investigated. J.Hughes

537.533.8

5935. CALCULATION OF ELECTRIC DIPOLE COULOMB EXCITATION AND DIPOLE BREMSSTRAHLUNG. R.M.Thaler, M.Goldstein, J.L.McHale and L.C.Biedenharn.
Phys. Rev., Vol. 102, No. 6, 1567-71 (June 15, 1956).

Numerical results are obtained for electric dipole Coulomb excitation. Tables of the dimensionless excitation function a_0 and the directional correlation parameter a_2 are presented over a very wide range of their arguments. It is shown that the dipole bremsstrahlung cross-section can be written in terms of the a_μ, so that the tabulation also serves for the calculation of the bremsstrahlung differential cross-section. A.

537.533.8

5936. DIFFERENTIAL CROSS-SECTION MEASUREMENTS OF THIN-TARGET BREMSSTRAHLUNG PRODUCED BY 2.7- TO 9.7-MeV ELECTRONS. N.Starfelt and H.W.Koch.
Phys. Rev., Vol. 102, No. 6, 1598-612 (June 15, 1956).

The electron beam removed from a 50 MeV betatron and a total-absorption scintillation spectrometer containing a sodium iodide crystal 5 in. in diameter and 9 in. long were used for the measurement of bremsstrahlung cross-sections that are differential in photon energy and angle. Thin targets of beryllium, aluminium and gold were bombarded by electrons with kinetic energies of 2.72, 4.54 and 9.66 MeV. The bremsstrahlung spectra from thick tungsten targets were also studied. The results were compared with the differential cross-section predictions of Sauter, Schiff,and Gluckstern and Hull. The spectral shapes obtained with the beryllium and aluminium targets agreed with those expected from theory for the electron energies of 2.72 and 4.54 MeV. The 9.66 MeV experiment gave 20% more low-energy than intermediate-energy photons when compared with theory. For gold the experimental cross-sections for the high photon energies are larger than theory with the differences increasing with decreasing electron primary energy. Evidence for electron–electron bremsstrahlung is obtained from the absolute magnitude of the differential cross-sections, which are $(Z + 1)/Z$ times larger than theory within the experimental errors. The thick-target tungsten spectra produced by 9.66 MeV electrons decreased more rapidly with increasing photon energy than did the thin-target cross-sections derived by Schiff.

537.533.8

5937. ENERGY AND ANGLE DISTRIBUTION OF ELECTRONS IN BREMSSTRAHLUNG. P.T.McCormick, D.G.Keiffer and G.Parzen.
Phys. Rev., Vol. 103, No. 1, 29-31 (July 1, 1956).

The cross-section $\sigma(E, \alpha)$ for an electron of incident energy E_0 to radiate in the presence of a nucleus with atomic number Z and to come out with energy E, at the angle α has been recalculated, checking the result of Racah. $\sigma(E, \alpha)$ has been tabulated for various outgoing energies and angles of the electron corresponding to incident momenta of 2mc, 4mc, 6mc, 10mc and 20 mc. For the case of large α, and large incident and final energies, $\sigma(E, \alpha)$ may be represented by a simple expression and the coefficients in this expression have been tabulated. This paper also collects the various formulae which are involved in this particular aspect of bremsstrahlung and which do not seem to be conveniently available in the literature. A.

537.533.8

5938. HIGH-SPEED ELECTRON MULTIPLICATION BY TRANSMISSION SECONDARY ELECTRON EMISSION. E.J.Sternglass.
Rev. sci. Instrum., Vol. 26, No. 12, 1202 (Dec., 1955).

The use of secondary emission from the far side of the target is advantageous from several points of view. Targets were made using KCl as an emitter with a frontal Au layer to scatter the primary beam. These layers were deposited on a SiO substrate 100 A thick. Yields of 6–8 were observed for 2.5-3.5 keV. The delay in emission was less than 10^{-10} sec. A.H.W.Beck

537.533.9

5939. SPECTRAL AND ANGULAR DISTRIBUTION OF ULTRAVIOLET RADIATION FROM THE 300-MeV CORNELL SYNCHROTRON. D.H.Tomboulian and P.L.Hartman.
Phys. Rev., Vol. 102, No. 6, 1423-47 (June 15, 1956).

The spectral characteristics of the radiation emitted by high-energy centripetally accelerated electrons have been examined for various electron energies over a wide wavelength range extending down to 60 A. Following preliminary remarks concerning the source and spectral distribution laws deduced from theory, the paper describes an experimental investigation of the spectrum. The spectrum is examined in the quartz region but the major portion of the work deals with measurements in the soft X-ray region where a grazing incidence vacuum spectrograph is used to record the average power spectrum emitted over a partial or full synchrotron acceleration interval during which the electron energy reaches the values of 233 MeV or 321 MeV respectively. In each case the radiation is detected photographically and photometric procedures are followed in reducing the spectrograms. The method of reduction takes into account aspects of the actual source, and a variety of instrumental factors dealing with the dispersion, the transmission, the spectral response, and also the geometrical effects of the optical system involved. The calibration of the emulsion is carried out according to schemes appropriate to each wavelength region. While heterochromatic photometry can be employed in the quartz region, in the vacuum region the emulsion response is taken as constant for fixed energy independent of wavelength. The wavelength dependence of the grating reflecting power is determined by calculations based on measurements with nearly monochromatic sources. This information makes it possible to reduce the exposures obtained with the synchrotron continuum over the wavelength region extending from 60 A to about 200 A. At longer wavelengths the grating response is deduced by treating a portion of the 233 MeV spectrum as known; the grating efficiency obtained in this manner is then used to reduce the corresponding portion of the 321 MeV exposure. The results on the spectral distributions are in reasonably good agreement with the corresponding predictions from classical radiation theory of accelerated electrons. The observed distribution in the spatial spread of the radiation at various positions in the spectrum can also be accounted for if a plausible model is adopted for the diffuseness of the actual source in verifying the theoretical expressions for the angular distribution due to a single radiator. It is pointed out that such continuous radiation may serve as a suitable source for making absorption measurements in the far ultraviolet. The absorption spectra of metallic Be and Al are obtained by the use of the continuum. The Be-K and Al-$L_{2,3}$ discontinuities, occurring at 111 A and 170 A respectively, are clearly visible in two orders. It is also suggested that the source may possibly be utilized as a standard for the purpose of calibrating detectors in the ultraviolet region. A.

537.533.9 : 621.385.83

5940. THE OPTIMUM LENGTH OF AN UNDULATOR. A.N.Matveev.
Zh. éksper. teor. Fiz., Vol. 28, No. 6, 760 (1955). In Russian.
English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 606-7 (Nov., 1955).

The power output of an undulator (Abstr. 5470/1951 and 6852/1953) depends strongly on the degree of bunching. During the flight of a bunch its size increases and the power output falls. On the other hand the radiated power increases linearly with undulator length. It follows that there is an optimum length which the author estimates to be given by $q = 10^6\sqrt{\lambda}/\sqrt{N}$ where λ is the wavelength in cm, of the radiation in the laboratory system, N the number of electrons in the bunch and q is the number of spatial periods of the undulator field. H.Motz

537.533.9

5941. MEASUREMENT OF THE TEMPERATURE RISE OF SPECIMENS IN ELECTRON DIFFRACTION. A.Winkelmann.
Z. angew. Phys., Vol. 8, No. 5, 218-21 (1956). In German.

Au/Cu foils containing 30% Au atoms undergo phase transition at 388°C. Hence examination of hot foils by electron diffraction enables the temperature rise following electron irradiation to be measured. The corresponding beam currents are determined galvanometrically. Temperature rises of 10°C are found for beam currents of 5×10^{-6} to 2.5×10^{-4} A/cm^2, in accordance with theory, assuming each electron passing through the foil drops 20 eV in energy. R.Reed

537.533.9

5942. TEMPERATURE RISE OF SPECIMENS IN THE ELECTRON BEAM. S.Yamaguchi.
Z. angew. Phys., Vol. 8, No. 5, 221-2 (1956). In German.

The rise in temperature of paraffin crystals of known melting point is followed by changes in the electron diffraction pattern and also by direct electron microscopic observation. The value for typical beam currents is below 50°C, in agreement with Winkelmann (see preceding abstract).

R.Reed

537.533.9 : 537.56 : 535.32

A QUANTUM THEORY OF REFRACTIVE INDEX, ČERENKOV RADIATION AND IONIZATION LOSS. See Abstr. 4975

537.534

5943. THE ACCELERATION OF PROTONS TO ENERGIES ABOVE 10 GeV. M.L.Oliphant.
Proc. Roy. Soc. A, Vol. 234, 441-56 (March 6, 1956).

Bakerian lecture. The importance to physics of work in the energy region above 10 GeV is pointed out, and the advantages of various proposed systems discussed. Linear accelerators and a simple, but not at present practical, electrostatically focused cyclic accelerator are briefly described. The ordinary and strong-focusing synchrotrons, and the F.F.A.G. (fixed field alternating gradient) accelerator are described and compared. Finally details of the air-cored 10 GeV proton synchrotron being built at Canberra are given; this machine is expected to be ready to operate by the middle of 1958.

J.H.Fremlin

537.534

5944. CONTINUAL INJECTION INTO CIRCULAR ION ACCELERATORS. L.C.Teng.
Rev. sci. Instrum., Vol. 27, No. 2, 106-7 (Feb., 1956).

The use of the magnetic regenerative deflector working "backwards" to inject ions continuously into either a weak- or strong-focusing accelerator is discussed and shown to be feasible in principle. A.J.Egginton

537.534.3 : 621.384 : 621.311.6

5945. COMPACT D.C. POWER SUPPLIES IN THE 100 kV REGION. H.C.Whitby.
Atomic Energy Res. Establ. (Harwell) Rep., No. GP/R 1855, 8 pp. (1956).

A unit is described for the supply of a stabilized d.c. voltage variable between 60 and 120 kV at currents up to 500 μa. The design was carried out to provide focusing potentials in a high intensity proton accelerator where compactness was of importance. A Cockroft–Walton system of many stages and operating at high-frequency is employed; inductance correction of shunt-capacity voltage-drop is included, resulting in high voltage efficiency. The system employs valve rectifiers with heaters supplied from a single high-voltage transformer. The multiplier elements, heater and h.f. power input transformers form a single, oil-immersed unit. A.

537.534.3

5946. ION OPTICS OF THE BEAM OF THE VAN DE GRAAF GENERATOR. H.Bruck and G.Gendreau.
Onde élect., Vol. 35, 1009-21 (Nov., 1955). In French.

A detailed discussion, with special reference to the 5 MeV machine of the Centre d'Etudes Nucleaires at Saclay. A Philips type source is used. The design of the focusing

lens and accelerator tube are briefly described. A consideration of the relative merits of electrostatic and magnetic monochromators concludes in favour of the latter. In the system adopted, a 90° uniform field sector, trajectory radius 60 cm, is preceded by a collimating lens consisting of two four-pole (hyperbolic field) magnets. In this way the aperture angle of the incident beam can be controlled, and, taking aberrations into account, optimized for maximum intensity, for a given required resolution. The design of apertures capable of adequate heat dissipation, methods of observing the beam and of aligning the components are briefly considered. So far resolutions of one part in 10^3 have been attained, but this is not regarded as an upper limit. E.A.Ash

537.534.3

5947. ON TWO DIRECTIONAL FOCUSSING MAGNETIC ANALYSERS. S.B.Karmohapatra.
Indian J. Phys., Vol. 29, No. 8, 393-7 (Aug., 1955).

Design parameters for a symmetrical two-directional non-uniform magnetic analyser are considered. Suggestions are made for achieving second-order radial focusing effect by properly shaping the pole edges of the first-order focusing conical magnets having an angle $< \sqrt{2}\pi$. The advantage of such a 180° magnet for mass-spectrometry is discussed in consideration with the resolving power and solid angle. A.

537.534.3

5948. CONTROL OF FILAMENT HEATING ON A MASS SPECTROGRAPH. C.Davila and P.Martin.
J. Phys. Radium, Vol. 17, No. 3, 41A - 43A (March Suppl., 1956). In French.

A control system is described for use with filaments carrying deposits of the substance to be studied. The filament was held at 2000 V d.c., and its resistance varied over the range 0.2 Ω-1 Ω with heating. The a.c. current could be varied from 1A-5A. Emission current stability was better than 1/1000 for slow voltage fluctuations of ±10%. N.M.King

537.534.3

5949. A STIGMATIC IMAGE DOUBLE FOCUSING MASS SPECTROGRAPH. H.Ewald and G.Sauermann.
Z. Naturforsch., Vol. 11a, No. 2, 173-4 (1956). In German.

By using the ion optical properties of a toroidal condenser (Abstr. 1300/1956) a double focusing modified form of the Mattauch–Herzog mass spectrometer was made. The radial and axial focusing are briefly discussed, and a photograph of typical doublet spectra given. J.Hughes

537.534.72 : 621.317.7.082.72

5950. AN ELECTROSTATIC ANALYSER FOR THE ABSOLUTE MEASUREMENT OF PROTON ENERGIES AND THE ESTABLISHMENT OF FIXED POINTS ON THE HIGH-VOLTAGE SCALE. S.E.Hunt, D.P.R.Petrie, K.Firth and A.J.Trott.
Proc. Instn Elect. Engrs, Paper No. 1840M, publ. May, 1955 (Vol. 103B, 146-51, 152-4).

Republication, with discussion, of the paper abstracted in Abstr. 6231 (1955).

537.534.74

5951. ON THE VARIATION OF p–p SCATTERING CROSS SECTION WITH ENERGY. C.C.Banerjee.
Indian J. Phys., Vol. 29, No. 8, 380-3 (Aug., 1955).

Attempts to find an empirical relation between the differential proton–proton scattering cross-section and the energy of the system. The relation proposed agrees fairly with the experimental data at high and low energies. A.

537.534.74

5952. ELASTIC AND INELASTIC SCATTERING OF LOW-VELOCITY H^- IONS IN HYDROGEN. E.E.Muschlitz, Jr, T.L.Bailey and J.H.Simons.
J. chem. Phys., Vol. 24, No. 6, 1202-9 (June, 1956).

An improved apparatus for the production of beams of negative ions and the measurement of the elastic and inelastic scattering of negative ions in gases at low pressures is briefly described. The measured cross-sections are given for the scattering of 4-400 eV H^- ions in hydrogen. In the range 4-40 eV (1.1-1.8 A) the interaction potential derived from the elastic scattering is $V\ (eV) = -4.64 \times 10^{-32}/r^4$ (r in cm) which is close to the theoretical polarization interaction. The inelastic scattering is presumed to be due to electron detachment. The inelastic cross-section increases from 1 cm^{-1} at 7 eV to 8.7 cm^{-1} at 395 eV. Above 75 eV the measured elastic cross-section increases with increasing ion energy. This is attributed to the appearance of inelastic collisions which result in electronic excitation of the hydrogen molecules. A.

537.534.74

5953. EXPERIMENTAL CROSS SECTIONS FOR CHARGE-CHANGING COLLISIONS OF He^+ AND He^{++} IONS TRAVERSING GASES. S.K.Allison, J.Cuevas and P.G.Murphy.
Phys. Rev., Vol. 102, No. 4, 1041-8 (May 15, 1956).

Ion beams of He^+ and He^{++}, in the kinetic energy range 100 to 450 keV, are held in arcs of circular orbits in a magnetic field. When a few microns of gas are admitted the beam is attenuated by charge-changing collisions, since with change of charge the ion is lost from its orbit. Cross-sections for such charge-changing collisions are designated by σ_{if}, where i is the initial positive ionic charge in electron units and f the charge after the collision. $(\sigma_{10} + \sigma_{12})$ has been directly measured for He^+ in hydrogen, helium, and air, and $(\sigma_{21} + \sigma_{20})$ for He^{++} in the same gases. Other observers have measured the equilibrium ratio He^+/He^{++} attained in a field-free beam after many collisions, and combining these data with the present observations allows calculation of σ_{10} and σ_{12} separately if one assumes σ_{02} negligible compared to the other cross-sections. The electron loss cross-sections σ_{12} increase with energy for helium and air throughout the measured region and are of the order 10^{-17} cm^2; σ_{12} for hydrogen v. energy shows a broad maximum at about 370 keV and 0.98×10^{-17} cm^2 per hydrogen atom. The capture cross-sections σ_{10} decrease rapidly in the measured energy range and in the region 200-450 keV those measured in helium agree, within the estimated experimental error, with theoretical calculations of H.Schiff. In attempting the resolution of the sums $(\sigma_{21} + \sigma_{20})$ into the separate cross-sections it is found that the errors in the measurements accumulate to such an extent that the individual values become very unreliable. An auxiliary experiment designed to increase the accuracy of knowledge of the separated capture cross-sections σ_{20} and σ_{21} is in progress. A.

537.534.74

5954. PHASE-SHIFT ANALYSIS OF PROTON–PROTON SCATTERING AT 150 MeV. S.Ohnuma and D.Feldman.
Phys. Rev., Vol. 102, No. 6, 1641-7 (June 15, 1956).

A phase-shift analysis of the 150 MeV proton–proton scattering and polarization data has been carried out assuming that only waves with $J \leq 2$ contribute and neglecting $^3P_2 - ^3F_2$ coupling. The formulae used to estimate the Coulomb-nuclear interference are essentially nonrelativistic, although they include a kinematic correction. Representative sets of phase shifts which fit the data reasonably are tabulated. A.

537.534.74

5955. EXPERIMENTS WITH 315-MeV POLARIZED PROTONS. I. ELASTIC SCATTERING BY COMPLEX NUCLEI. O.Chamberlain, E.Segrè, R.D.Tripp, C.Wiegand and T.Ypsilantis.
Phys. Rev., Vol. 102, No. 6, 1659-75 (June 15, 1956).

The essentials of the theory of polarization of particles of spin $\frac{1}{2}$ are given in a form suitable for the interpretation of the experimental results. Included is a detailed description of the experimental techniques, the characteristics of the polarized beam, and a discussion of the errors of measurement. The beam was 76% polarized and the maximum beam current was

approximately 10 protons per second. Results of the scattering experiments on beryllium, carbon, aluminium, calcium, iron, and tantalum are described. Some results of triple-scattering experiments, which further determine the scattering matrix, are also given. The relation of the experimental results to the various theories proposed for explaining the polarization by scattering is discussed. Only qualitative agreement with the theoretical studies made on current models is achieved. Although many of the features predicted by the usual types of potentials are present, no single potential can account for all the observed facts. A.

537.534.75.

5956. THE MEASUREMENT OF IONIZATION BY MEANS OF "BLOB" LENGTHS IN NUCLEAR EMULSION. Tsai-Chü, M.C. Le Gentil and M.Morand.
C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 1974-6 (April 16, 1956). In French.

The lengths of blobs in tracks of 4.2 BeV protons have been measured by means of an eyepiece micrometer to an accuracy of 0.05 μ. The distribution of blob length is asymmetrical about the expected value of the length of one grain. The number decreases exponentially with length. The results have been applied to the mass determination of particles near the end of their range. D.J.Prowse

537.534.8

5957. ELECTRON MULTIPLIERS IN MASS SPECTROMETRY; EFFECT OF MOLECULAR STRUCTURE. H.E.Stanton, W.A.Chupka and M.G.Inghram.
Rev. sci Instrum, Vol. 27, No. 2, 109 (Feb., 1956).

Pulse height measurements were carried out to determine the discriminatory effect of secondary electron production from heavy polyatomic ions and monatomic ions of the same mass and energy. Ions studied were $C_{14}H_{10}^{+}$ (mass 178) and Hg^{204+}; different ion masses were chosen to minimize background, and the results corrected to relate $C_{14}H_{10}^{+}$ and Hf^{178+}. The measured ratio was 2.2. Suggests the effect may be useful in isotopic analysis. N.M.King

537.534.8

5958. IN CONNECTION WITH THE PAPER OF ARIFOV, AYUKHANOV AND STARODUBTSEV. M.A.Eremeev.
Zh. éksper. teor. Fiz., Vol. 28, No. 3, 376 (1955). In Russian.
English translation in: Soviet Physics JETP (New York), Vol. 1, No. 2, 390 (Sept., 1955).

Allegedly incorrect interpretation of data on the decrease of the number of atoms adsorbed on a surface due to a rise in temperature by Eremeev is the basis of criticism in a paper by Arifov, Ayukhnov and Starodubtsev. (See Abstr. 1923/1955). Eremeev points out that entirely different (and correct) statements were, however, given in his paper (See Abstr. 1070/1952). C.G.Morgan

537.534.8 : 539.172.13

5959. GAMMA RADIATION ACCOMPANYING THE ABSORPTION OF FAST PROTONS BY NUCLEI. A.I.Akhiezer and I.Ya.Pomeranchuk.
Zh. eksper. teor. Fiz., Vol. 30, No. 1, 201-3 (1956). In Russian.

Bremsstrahlung, in particular that due to the anomalous moment of the proton, is calculated for the case where the absorbing nucleus is considered as black to the proton. G.E.Brown

537.534.8

5960. A NEW METHOD OF MEASURING VERY SMALL ION CURRENTS IN HIGH VACUUM. W.Schütze and F.Bernnard.
Z. Phys., Vol. 145, No. 1, 44-7 (1956). In German.

The method used consists in accelerating the ions up to 10 to 20 keV and allowing them to fall on a metal plate [Ni, Mo, Pt, Cu–Be...] to produce secondary electrons. These in turn are accelerated through the same voltage to fall on a ZnO scintillator on a plane glass surface in the vacuum. Behind the plate and outside the vacuum is a photomultiplier to detect the scintillations. This method is claimed to have all the advantages and none of the disadvantages of the Allen type ion detector and of the Richards and Hays scintillation ion detector. C.G.Morgan

DISCHARGE TUBES. COUNTERS 537.54

537.542

5961. ON A THERMAL ION-SOURCE WITH EXTREMELY LOW CONSUMPTION OF THE SUBSTANCE. H.Hintenberger and C.Lang.
Z. Naturforsch., Vol. 11a, No. 2, 167-8 (1956). In German.

An improvement of previous ion sources (see Abstr. 3673/1952 and Abstr. 6866/1953) is described in which the substance is heated by one heating coil and ionized in an annular space heated by another coil, in such a way that the substance can only escape through a small exit slit. Quantities of Ru and Cs of 5×10^{-13} g can be observed in a mass spectrograph for several minutes. H.Motz

537.542

5962. ON THE USE OF CYCLOPROPANE ON A SELF-QUENCHING GAS FOR GEIGER COUNTER FILLINGS. J.-P.Vigne.
C. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1879-80 (April 9, 1956). In French.

Gives data on dead time, recovery time and pulse size etc for argon–cyclopropane counter fillings. Comparisons are made with the same data obtained with argon–alcohol fillings. J.D.Craggs

537.542

5963. THE TEMPERATURE COEFFICIENT AND THERMAL STABILITY OF SELF-QUENCHING GEIGER–MÜLLER COUNTERS CONTAINING AN ORGANIC VAPOUR. D.Blanc and R.Viste.
Nuovo Cimento (Ser.10), Vol. 3, No. 5, 1119-30 (May, 1956). In French.

Discusses in great detail, with many references, the experimental study of temperature effects in counters containing self-quenching vapours. Data are given for various gas-vapour fillings, on temperature coefficients, plateau length variations with temperature etc. Internal and external cathodes are considered J.D.Craggs

537.542

5964. N-PENTANE AS STABILIZING AGENT IN PROPORTIONAL COUNTERS. H.C.Hamers and T.J.de Boer.
Physica, Vol. 22, No. 5, 443-8 (May, 1956).

The energy resolution in argon n-pentane and krypton n-pentane as well as in argon alcohol and krypton alcohol mixtures is studied. N-pentane is found to be a satisfactory polyatomic constituent for proportional counters. A.

537.542 : 548.733

5965. USE OF PROPORTIONAL COUNTERS IN X-RAY DIFFRACTION. H.R.Laird and M.J.Zunick.
Trans Amer. Inst. Elect. Engrs I, Vol. 74, 734-7 (1955) = Commun. and Electronics, No. 22 (Jan., 1956).

Describes fully the characteristics of proportional counters for X-ray diffraction work. Tube geometries, intensity calibrations, plateau characteristics and efficiency–wavelength curves are shown. Pressures (A, Kr or Xe) ~ 40 - 65 cm Hg were used. The wavelength range was from about 0.2 to 2.2 A. The advantages of proportional counters, as compared with Geiger counters, are long life, reduction of coincidence losses and elimination of the quench circuit. J.D.Craggs

537.542

5966. A WINDOWLESS FLOW COUNTER FOR PAPER STRIPS. J.M.Lowenstein and P.P.Cohen.
Nucleonics, Vol. 14, No. 5, 98-100 (May, 1956).

Constructional details are given of a G.M. counter designed for chromatogram use. The counter automatically scans paper strips of width up to 1.28 in. and of any desired length.

R.D.Smith

537.542 : 539.165

5967. A BETA-RAY SCINTILLATION SPECTROMETER WITH OPTIMUM RESOLUTION. S.Gorodetzky, R.Armbruster, P.Chevallier and A.Gallmann.
J. Phys. Radium, Vol. 16, No. 12, 939-40 (Dec., 1955). In French.

Apparatus designed to measure the energy of electron pairs by addition of the energies of positive and negative electrons was described in a previous paper (Abstr. 2201/1956). Results obtained using several solid scintillators are described. The use of a light-pipe between the scintillator and the photomultiplier improves the resolution by diffusing the pulses over the photocathode. G.F.J.Garlick

537.542

5968. SOLID SCINTILLATORS FOR BETA RAY SPECTROMETRY. A.Bisi, E.Germagnoli and L.Zappa.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1007-16 (May, 1956).

A beta-ray spectrometer and a β-γ coincidence spectrometer using anthracene crystals are described. The results of some measurements concerning simple and complex decays are given. In particular the decay of Tm^{170} has been reinvestigated. A.

537.542

5969. GASEOUS SCINTILLATION COUNTING. C.Eggler and C.M.Huddleston.
Nucleonics, Vol. 14, No. 4, 34-6 (April, 1956).

The detection of charged particles by the measurement of the light emitted by excited atoms in the track of the particle is reviewed briefly. Important characteristics are short pulse rise times (10^{-8} sec) and insensitivity to γ-rays. A gas scintillation counter containing 5 atm A is described. With a standard photomultiplier and a plastic colour shifter a resolution of about 15% for 5.47 MeV α-particles was obtained. Results of measurements on the use of nitrogen as a colour shifter are given. R.D.Smith

537.542

5970. LOS ALAMOS GAS COUNTERS. J.A.Northrop and R.Nobles.
Nucleonics, Vol. 14, No. 4, 36-7 (April, 1956).

Results are given for the effect on pulse height of H_2, N_2, O_2 and CH_4 contaminants in Xe scintillation counters. An evaporated coating of quaterphenyl on the photomultiplier tube face and MgO reflector was found to be an effective colour-shifter. Relative light outputs from noble gases and NaI(Tl) were NaI : Xe : Kr A : Ne : He = 72 : 32 : 16 : 5 : 1 : 10. Scintillations from liquids and solid noble gases are also briefly mentioned. R.D.Smith

537.542

5971. NEUTRON SCINTILLATION COUNTERS. C.O.Muehlhause.
Nucleonics, Vol. 14, No. 4, 38-9 (April, 1956).

Existing types of neutron scintillation detectors and their important properties are tabulated. Attention is drawn to two possible scintillators, LiH crystal and hydrogen gas. If suitable activators and colour shifters could be found these would make very useful neutron detectors. R.D.Smith

537.542

5972. REDUCTION OF NaI BACKGROUND. C.E.Miller, L.D.Marinelli, R.E.Rowland and J.E.Rose.
Nucleonics, Vol. 14, No. 4, 40-3 (April, 1956).

Results are given of a careful investigation of the residua background of NaI(Tl) crystals used as scintillators. Eight inches of steel plus one inch of triple distilled Hg was found sufficient to eliminate local activity. The contributions to the residual activity from the multiplier tube, from the K^{40} impurity in the crystal and from cosmic radiation were determined, and possible sources of an apparent residual activity in the crystal of about 0.04 counts per minute/g discussed. The elimination of spurious electronic pulses in a low-background counting system is described. R.D.Smith

537.542

5973. LIQUID SCINTILLATORS WITH HEAVY ELEMENTS. H.P.Kallmann, M.Furst and F.H.Brown.
Nucleonics, Vol. 14, No. 4, 48 (April,1956).

The use of naphthalene or biphenyl as an intermediate energy transferrer makes possible efficient scintillation solutions containing compounds that would otherwise greatly reduce the light output. A table is given showing the light output of such solutions containing various salts (including lead acetate and uranium nitrate) at concentrations of 10-20 g/l.

R.D.Smith

537.542

5974. LIQUID-SCINTILLATOR TEMPERATURE EFFECTS. H.H.Seliger and C.A.Ziegler.
Nucleonics, Vol. 14, No. 4, 49 (April, 1956).

The light output due to α-particle excitation of gas-free liquid scintillators was found to increase with decreasing temperature. With xylene as a solvent temperature coefficients were: D.P.O. (4 g/l) 0.6%/°C; P.B.D. (8 g/l) and α-N.P.O. (3.2 g/l) 0.4%/°C. Preliminary results with gamma excitation agree with the α-particle data. R.D.Smith

537.542

5975. THREE WAYS TO INCREASE EFFICIENCY OF LIQUID SCINTILLATORS. C.A.Ziegler, H.H.Seliger and I.Jaffe.
Nucleonics, Vol. 14, No. 5, 84, 86 (May, 1956).

The effect on the light output of p-terphenyl in xylene and P.P.O. in xylene of (a) removal of O_2 and other dissolved gases (b) addition of α.NPO as a wavelength shifter and (c) reduction in temperature, were investigated. Gas-free solutions prepared by distillation in vacuum showed an increase in light output compared with air-saturated solutions, particularly for low solute concentration. Cooling from 28°C to 0°C also resulted in increased light output; the effect being most marked for de-gassed solutions of low concentration. The mechanism of the quenching of the radiation by oxygen is briefly discussed.

R.D.Smith

537.542 : 537.533.9

5976. HIGH ENERGY CERENKOV COUNTER. C.E.Swartz.
Nucleonics, Vol. 14, No. 4, 44 (April, 1956).

A brief description of a spectrometer consisting of a 12 in. diameter glass cylinder, 16 in. long, viewed by a 16 in. photomultiplier. An energy resolution of better than 30% was obtained for 450 MeV electrons. R.D.Smith

537.542 : 537.533.9

5977. INTERACTIONS OF ANTIPROTONS IN LEAD GLASS. J.M.Brabant, B.Cork, N.Horwitz, B.J.Moyer, J.J.Murray, R.Wallace and W.A.Wenzel.
Phys. Rev., Vol. 102, No. 6, 1622-6 (June 15, 1956).

An analysis is presented of the pulse distribution produced by antiprotons of 1.2 BeV/c momentum entering a lead-glass Cherenkov counter. The calibration of the counter is described. Estimates of the efficiency of containment of the relativistic secondary particles and electronic showers from

annihilation events are discussed and shown to be compatible with the observed pulse-height spectrum. Attenuation effects in a copper absorber preceding the counter, and in the first of two sections of the glass counter, demonstrate interaction and absorption cross-sections that are nearly twice geometric and which probably increase as the antiproton kinetic energy decreases below 400 MeV. A.

537.542 : 621.374.32

5978. THE RESOLVER, A CIRCUIT FOR REDUCING THE COUNTING LOSSES OF A SCALER. R.E.Bell.
Canad. J. Phys., Vol. 34, No. 6, 563-76 (June, 1956).

The resolver is a circuit that reduces the counting losses of an ordinary scaler by storing up most of the pulses that otherwise would be lost in dead time, and releasing them uniformly at a safe rate for the scaler. Even for very short input pulses, the circuit contains no active elements that need to be fast enough to follow these pulses, and is thus simpler than an equivalent fast scaler. In a typical case the maximum permissible counting rate of the scaler is raised by a factor of the order of 30. The counting losses of such a circuit are computed. A detailed circuit and the results of tests on it are shown. A.

537.542

5979. MILLIMICROSECOND COINCIDENCE CIRCUITS. Z.Bay.
Nucleonics, Vol. 14, No. 4, 56-60 (April, 1956).

A review of the fast coincidence circuits developed in the last few years. The circuits are classified according to their mode of operation. An account is given of the differential coincidence method enabling resolving times of 10^{-10} sec to be achieved. R.D.Smith

537.542

5980. A NEW DETECTOR OF IONIZING RADIATION. THE GAS BUBBLE CHAMBER. P.E.Argan and A.Gigli.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1171-2 (May, 1956).

The successful construction and operation of a bubble chamber filled with a supersaturated solution of carbon dioxide in diethyl-ether is briefly reported. The device, consisting of a stainless steel cylindrical chamber having a useful volume of 200 cm^3 and ending with two glass windows, is operated at room temperature. The expansion is provided by means of a polythene diaphragm moving under the action of compressed air. The release of the pressure inside the chamber during the expansion takes about 6-7 msec. The growth of the bubbles is much slower than in overheated liquids: good photographs of tracks of Compton electrons from γ-rays, taken with ordinary flashlamps, are shown. G.Martelli

537.542

5981. LIQUID XENON BUBBLE CHAMBER. J.L.Brown, D.A.Glaser and M.L.Perl.
Phys. Rev., Vol. 102, No. 2, 586-7 (April 15, 1956).

The successful construction and operation of a liquid xenon filled bubble chamber of 1 in. diameter is reported, and the advantages arising from the use of a high density liquid (2.3 g/cm^3) to detect γ-rays are briefly discussed. Because of the scintillation efficiency of the xenon, a "quenching" additional fraction of ethylene was found necessary to prevent a sizeable fraction of the energy lost by ionizing particles to escape in optical radiation. When used as particle detector, the device has many properties similar to those of nuclear emulsion. It is suggested that it will be possible to adjust the percentage of hydrocarbon admixture so as to let the liquid retain some of its scintillating efficiency and also produce bubbles tracks. Spatial as well temporal information for each process should then be obtained. G.Martelli

537.542

5982. BUBBLE COUNTING FOR THE DETERMINATION OF THE VELOCITIES OF CHARGED PARTICLES IN BUBBLE CHAMBERS. D.A.Glaser, D.C.Rahm and C.Dodd.
Phys. Rev., Vol. 102, No. 6, 1653-8 (June 15, 1956).

The density of bubbles along tracks in a liquid propane bubble chamber has been measured as a function of particle velocity for positive pions and protons with velocities $\beta = v/c > 0.4$. For temperatures from 55°C to 59.5°C the bubble density, b, is described by $b = (A/\beta^2) + B(T)$, where $A = 9.2 \pm 0.2$ bubbles/cm and B is a function of temperature only. Velocities can be determined by bubble counting, using fast comparison tracks of known velocity, with a final average error in velocity of 5% for proton tracks 10 cm long. Accurate temperature control is not required to obtain this accuracy by using this method. A.

IONIZATION. THERMIONICS 537.56/58

537.56

5983. THE DIFFUSION OF ELECTRONS IN A GAS [H_2 AND N_2] AT LOW TEMPERATURES. B.I.H.Hall.
Austral. J. Phys., Vol. 8, No. 4, 551-4 (Dec., 1955).

The mean energy of agitation Q of electrons moving under the influence of a small uniform electric field Z, in a gas of molecular concentration n at a temperature of about −190°C, was measured as a function of Z/n. Comparison of the results with those previously obtained at room temperatures by Crompton and Sutton using essentially the same apparatus (Abstr. 2508/1953), shows that for a constant Z and fixed n, Q is independent of the energy of the gas molecules. J.Dutton

537.562

5984. THE [CHARGE] CARRIER DENSITY IN A PLASMA AND ITS MEASUREMENT WITH THE IMPULSE PROBE. D.Kamke and H.J.Rose.
Z. Phys., Vol. 145, No. 1, 83-115 (1956). In German.

Briefly describes the use of Langmuir probes with reference to the transition layer between the probe and the undisturbed plasma. Then a new method, involving the sudden application to a negative probe of a large voltage (~ 100 V), is described with which certain difficulties due to the transition layer are eliminated. Detailed theoretical discussion and experimental data are given, with a block diagram of the circuit and oscillograms of probe currents. J.D.Craggs

537.562 : 537.523.5

DETERMINATION OF THE ABSOLUTE CONCENTRATIONS OF ATOMS IN A MULTI-COMPONENT ARC VAPOUR. See Abstr. 5123

537.564

5985. IONIZATION AND DISSOCIATION OF NITROGEN TRIFLUORIDE BY ELECTRON IMPACT. R.M.Reese and V.H.Dibeler.
J. chem. Phys., Vol. 24, No. 6, 1175-7 (June, 1956).

A mass spectrometric study of nitrogen trifluoride provides data on the relative abundances and appearance potentials of the NF_3^+, NF_2^+, NF^+, F^+, F^-, and F_2^- ions. The heat of formation of the NF_3 molecule is used to determine the probable processes of formation of the N^+ and F^+ ions and to calculate the ionization potentials of the NF and NF_2 radicals. A.

537.564 : 537.534.74

5986. CHARGE ANALYSIS AND DIFFERENTIAL CROSS-SECTION MEASUREMENTS FOR LARGE-ANGLE ARGON ION–ARGON ATOM COLLISIONS WITH ENERGIES BETWEEN 25 AND 138 keV. R.J.Carbone, E.N.Fuls and E.Everhart.
Phys. Rev., Vol. 102, No. 6, 1524-30 (June 15, 1956).

The charge states and differential cross-sections of the scattered particles at each angle have been measured for individual collisions between argon ions and argon atoms at large angles. The angular interval ranged from 4 to 20 degrees with a resolution of one degree. Data are presented for several energies between 25 and 138 keV inclusive. The ion

beam traversed a collision chamber which contained the target gas argon. The pressure was maintained low enough to insure that the collision products resulted from two-body interactions, i.e., from single collisions. The scattered particles at each angle passed through a pair of collimating holes and then through an electrostatic analyser. Percentages in various charge states, ranging from neutral to seven times ionized, were measured. The extent of ionization is found to be a function of the distance of closest approach during the collision in question and not primarily a function of the energy. The data are also used to determine the absolute differential cross-section for scattering of particles. These cross-sections are lower than those predicted for simple Coulomb scattering because of the screening effect of the atomic electrons. Agreement is good between the measured cross-sections and those calculated from an exponentially screened Coulomb potential. A.

537.57 : 535.371

ON THE INTERPRETATION OF THE IONIZATION AND THE LUMINESCENCE PRODUCED BY HYDRATION OF THE ORGANIC SALTS OF QUININE AND QUINIDINE. See Abstr. 5008

COSMIC RAYS 537.591

537.591 : 530.162

ON THE THEORY OF STOCHASTIC PROCESSES IN COSMIC RADIATION. See Abstr. 4853

537.591.1

5987. THE FLUX OF THE HELIUM COMPONENT OF THE PRIMARY COSMIC RADIATION AT GEOMAGNETIC LATITUDE 41°N. A.De Marco, A.Milone and M.Reinharz.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1150-2 (May, 1956).

Alpha-particle primaries were selected by ionization–scattering measurements in emulsion from the 1953 Sardinian Expedition. An absolute intensity $I_\alpha = 39 \pm 8.6$ He/m^2.ster. was obtained, significantly lower than that given by other workers at the same geomagnetic latitude. It is pointed out that Fay (Abstr. 8881/1955) obtained a low absolute intensity for primaries of $Z > 2$ using emulsion exposed during a different flight of the same expedition. R.H.W.Johnston

537.591.15

5988. NOTE ON THE TECHNIQUE OF EXPERIMENTS ON AIR SHOWER TIME VARIATIONS. K.Sitte.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1145-7 (May, 1956).

Reasons are suggested for the inconclusiveness of most time variation experiments to date. It is suggested that low-density shower contamination may be reduced by using a larger number of counters in coincidence. The effect is illustrated with calculated curves. Some old air-shower data were re-examined. Selecting sub-samples of higher energy ($\sim 10^{15}$-10^{16} eV) enabled a diurnal effect to be suggested (with marginal statistics), while the data taken are together ($> 10^{14}$ eV) gave no effect. R.H.W.Johnston

537.591.15

5989. CLOUD-CHAMBER STUDY OF THE SECOND MAXIMUM. B.Hodge and L.W.Morris.
Phys. Rev., Vol. 102, No. 4, 1164-7 (May 15, 1956).

A 12 in. G.M. tube controlled cloud chamber was used to study the second maximum of the shower transition curve for lead. Stereoscopic pictures were taken to study the angular divergence of the pairs produced. Over 14 000 photographs were analysed for a range of lead thickness from 10 to 23 cm. The frames with pairs were reprojected and the angular divergence of the tracks measured with a protractor. The experimental results appear to indicate a second maximum at a thickness in the neighbourhood of 17.5 cm lead. A.

537.591.5 : 523.74

5990. COSMIC RAY INTENSITY DURING SOLAR FLARE OF FEBRUARY 23, 1956. M.A.Assies amd H.F.Jongen.
Physica, Vol. 22, No. 4, 355-6 (April, 1956).

Gives a brief account of increase in cosmic-ray intensity recorded in Amsterdam using ionization chambers. The increase, which began between 0343 and 0345 G.M.T., was beyond the range of the equipment but it is estimated that the intensity increased to approximately three times normal. P.Rothwe

537.591.5 : 523.74

5991. COSMIC RADIATION DURING THE SOLAR FLARE OF FEBRUARY 23rd AND ITS EFFECT ON ^{14}C AGE MEASUREMENTS. H.De Vries.
Physica, Vol. 22, No. 4, 357 (April, 1956).

An increase in counting rate was observed with a BF_3 neutron counter in Amsterdam at the time of the flare. There being no automatic recording, an average value, for the period 2130 G.M.T. Feb., 22 to 0720 G.M.T. Feb., 23 only, was observed. This was between 3 and 4 times normal. An increase in counting rate was also observed for counters filled with CO_2 used for C^{14} age measurements. P.Rothwel

537.591.5 : 523.7

5992. INCREASE OF COSMIC RAY INTENSITY ASSOCIATED WITH THE SOLAR FLARE OF FEBRUARY 23, 1956. F.Bachelet and A.M.Conforto.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1153-5 (May, 1956).

Vertical and inclined (30° from zenith, towards N and S) telescopes of counting rates 4.7×10^4/hr and 2.7×10^4/hr respectively have recorded continuously since October 1953. A 310% increase was observed for the vertical telescope. Smaller % increases for the inclined telescopes were observed, which indicates that the particles had a high atmospheric absorption coefficient and were of low energy. R.H.W.Johnsto

537.591.5 : 550.3

5993. INFLUENCE OF GEOMAGNETIC QUADRUPOLE FIELDS UPON COSMIC-RAY INTENSITY. F.S.Jory.
Phys. Rev., Vol. 102, No. 4, 1167-73 (May 15, 1956).

The effect upon cosmic-ray particles of the quadrupole part of the earth's magnetic field has been calculated, using the results of the magnetic survey of 1945. The effect predicted from the zonal quadrupole term is a northern shift of the cosmic-ray latitude curve. The 1945 magnetic centre wa calculated, using Schmidt's method, and it is 0.0629 earth radii from the centre of the earth, as compared to 0.0536 earth radii in 1922. The shift in magnetic centre results in an increase in the predicted longitude effect. The residual o sectorial quadrupole effect upon cosmic-ray intensity is predicted to be a two-period sine curve in the longitude effect.

537.591

5994. HIGH-ALTITUDE COSMIC-RAY NEUTRON INTENSITY VARIATIONS. R.K.Soberman.
Phys. Rev., Vol. 102, No. 5, 1399-409 (June 1, 1956).

Three groups of balloon flights carrying unshielded boron trifluoride counters were made from geomagnetic latitudes 10.1°N, 55.1°N and 88.6 °N. From the data obtained, curves of slow-neutron intensity v. atmospheric depth for depths less than 700 millibars are plotted. The mean absorption lengths for neutrons in the equilibrium portion of the atmosphere were found to be $L(10.1^\circ) = 212$ g/cm^2, $L(55.1^\circ) = 164$ g/cm^2 and $L(88.6^\circ) = 164$ g/cm^2. The depths of the neutron intensity maxima were found to be $\theta_{max}(10.1^\circ) = 120 \pm 5$ mb, θ_{max} 55 $= 100 \pm 5$ mb, $\theta_{max}(88.6^\circ) = 75 \pm 5$ mb. From these results and those of other investigators, the variation of the mean absorption coefficient ($\mu = 1$ L) and the depth of the neutron intensity maximum are plotted as functions of the geomagnetic latitude. A family of curves of neutron intensity v. atmosphe

epth is drawn for geomagnetic latitudes at 10 degree intervals etween 0° and 90°N, and from this the low-energy neutron apture per square centimetre per second by the $N^{14}(n, p)$ reac-.on in the atmosphere is calculated and plotted as a function of eomagnetic latitude. It is found that the observed neutron ntensity varies by about 420% from 0° to 90°N. A value of .8 x 10^{18} sec^{-1} is obtained for the total number of low-energy eutrons captured in the atmosphere. A.

537.591.5 : 550.38

5995. EFFECTIVE GEOMAGNETIC EQUATOR FOR COS-MIC RADIATION. J.A.Simpson, K.B.Fenton, J.Katzman and D.C.Rose.

Phys. Rev., Vol. 102, No. 6, 1648-53 (June 15, 1956).

The distribution of the geomagnetic field extending far rom the surface of the earth is investigated by using cosmic-ray particles as probes. Since for any longitude the cosmic-ray intensity reaches a minimum at the effective geomagnetic equator of this outer field, a series of determinations of the minimum intensity at several longitudes defines its effective equatorial plane. Measurements using the neutron intensity rom the nucleonic component prove that large discrepancies exist between experimental observations and the presently accepted geomagnetic coordinates derived from surface mag-netic field measurements. It is also found that meson inten-sity data from the past 20 years or more may be used to determine minima at other longitudes. The results indicate that the effective geomagnetic equator for cosmic rays is sim-ulated by a westward shift of the inclined magnetic dipole of the earth by about 40°-45°, without requiring an appreciable change in the angle of inclination. Several anomalous results which have been reported at intermediate and equatorial lati-tudes for primary alpha particles and heavy stripped nuclei detected in photoemulsions are readily explained by this shift in coordinates, supporting the view that the discrepancies are vorld-wide in character. Since the surface magnetic field measurements do not account for this large-scale effect, it s suggested that the explanation may be found from the inter-action of the rotating and inclined magnetic dipole field with a highly ionized interplanetary medium. A.

MAGNETISM 538

538.082/.083

996. CHARACTERISTIC PROPERTIES OF DEAD-BEAT GALVANOMETERS USED AS PARTIAL FLUXMETERS. .Selzer.

'. R. Acad. Sci. (Paris), Vol. 242, No. 11, 1422-5 (March 12, 956). In French.

Describes the response of a galvanometer under the action f an external steady, alternating or instantaneously changing ield. E.P.Wohlfarth

538.082

997. AN IMPROVED METHOD OF MEASURING THE BSOLUTE SUSCEPTIBILITIES OF SINGLE CRYSTALS OVER IDE RANGES OF TEMPERATURES. S.K.Dutta Roy.

ndian J. Phys., Vol. 29, No. 9, 429-45 (Sept., 1955).

An accurate, convenient method has been developed for ne measurement of magnetic susceptibilities of single-crystal owders and solutions over wide ranges of temperatures. This s based on the Curie method in which various sources of rrors have been individually and collectively eliminated to ive an accuracy of not less than 0.2%. The present paper ives a detailed description of the balance and a gas-flow type orizontal cryostat for temperature variation. The calibration f the balance and the Cu—constantan thermocouple tempera-ure scale have also been compared against the existing Leiden, trasbourg and Calcutta measurements, on standard paramag-etic substances, e.g., Cr^{+++} alum, Fe^{+++} alum and $iSO_4.6H_2O$, the first two of which provide the magnetic scale f extreme low temperatures. A.

538.114 : 536.7

5998. GENERAL THEORY OF SPIN-WAVE INTERACTIONS. F.J.Dyson.

Phys. Rev., Vol. 102, No. 5, 1217-30 (June 1, 1956).

An ideal model of a ferromagnet is studied, consisting of a lattice of identical spins with cubic symmetry and with iso-tropic exchange coupling between nearest neighbours. The aim is to obtain a complete description of the thermodynamic properties of the system at low temperatures, far below the Curie point. In this temperature region the natural description of the states of the system is in terms of Bloch spin waves. The nonorthogonality of spin-wave states raises basic difficul-ties which are examined and overcome. The following new results are obtained: a practical method for calculating ther-modynamic quantities in terms of a nonorthogonal set of basic states; a proof that in 3 dimensions there do not exist states (shown by Bethe to exist in a one-dimensional chain of spins) in which two spins are bound together into a stable complex and travel together through the lattice; a calculation of the scattering cross-section of two spin waves, giving a mean free path for spin—spin collisions proportional to $T^{-7/2}$ at low temperatures; and an exact formula for the free energy of the system, showing explicitly the effects of spin-wave inter-actions. Quantitative results based on this theory are published in a second paper (abstract following). A.

538.114 : 536.7

5999. THERMODYNAMIC BEHAVIOR OF AN IDEAL FERRO-MAGNET. F.J.Dyson.

Phys. Rev., Vol. 102, No. 5, 1230-44 (June 1, 1956).

The free energy of an ideal Heisenberg-model ferromagnet is calculated as a power series in the temperature T, using the mathematical machinery developed in an earlier paper (preceding abstract). The spontaneous magnetization in zero external field is given by

$$[M(T)/M(0)] = S - a_0\theta^{3/2} - a_1\theta^{5/2} - a_2\theta^{7/2} - a_3S^{-1}\theta^4 + O(\theta^{9/2}).$$

Here θ is the temperature in dimensionless units, and a_0, a_1, a_2, a_3 are positive numerical coefficients which are computed for the three types of cubic crystal lattice. The first two terms are the result of the simple Bloch theory in which spin waves are treated as noninteracting Bose particles with con-stant effective mass. The a_1 and a_2 corrections come from the variation of effective mass with velocity. The a_3 term is the lowest-order correction arising from interaction between spin waves. This result is in violent contradiction to earlier pub-lished calculations which gave interaction effects proportional to $T^{7/4}$ and T^2. The smallness of the thermodynamic effects of spin-wave interaction is discussed in physical terms, and par-tially explained, in the introduction of this paper. A general proof is given that the thermodynamic effects of the "exclusion principle", which forbids more than (2S) spin deviations to occupy the same atom, are of order $\exp(-a\theta^{-1})$ and give zero contribution to any finite power of θ. The residual dynamical interaction between 2 spin waves gives rise to a second virial coefficient b_2' which is calculated and shown to be of order $T^{5/2}$. The a_3 term in the magnetization is proportional to b_2'. Effects of interaction of 3 or more spin-waves are estimated and found to be of order θ^5 or higher. A.

538.114

6000. CONSTANT COUPLING APPROXIMATION FOR ANTIFERROMAGNETISM. P.W.Kasteleijn and J.van Kranen-donk.

Physica, Vol. 22, No. 5, 367-85 (May, 1956).

The method developed in Abstr. 5210 (1956) for the inves-tigation of the statistical properties of a Heisenberg ferromag-netic spin system is extended to an antiferromagnetic spin sys-tem with a two-sublattice structure and an isotropic coupling between nearest neighbouring spins. Both the case of a paral-lel and of a perpendicular external field are discussed. The partition function of the spin system is expressed in terms of the effective Hamiltonian H_e of a pair of nearest neighbouring spins. In the parallel case, H_e contains, in addition to the

isotropic and anisotropic coupling terms and the effective field term occurring also in the ferromagnetic case, a term representing a staggered effective field which has the same magnitude but opposite direction for the two spins of the spin pair. In the perpendicular case two additional anisotropic coupling terms appear, so that H_e contains six terms in this case. By introducing specific assumptions about the values of the coupling parameters occurring in H_e, the molecular field and the constant coupling approximation are obtained. The thermodynamic properties of the spin system, and in particular the critical data, are calculated on the basis of the constant coupling approximation, and numerical results are given for the simple cubic and body-centred cubic lattice. In contradistinction to the ferromagnetic case the constant coupling approximation for an antiferromagnetic spin system leads to the appearance of an anti-Curie point, so that in this case the constant coupling approximation is reliable only above and in the immediate vicinity of the Curie point. A.

538.114

6001. CONSTANT COUPLING APPROXIMATION FOR ISING SPIN SYSTEMS. P.W.Kasteleijn.
Physica, Vol. 22, No. 5, 387-96 (May, 1956).

The constant coupling approximation for ferro- and antiferromagnetic spin systems with isotropic nearest neighbour interaction (see preceding abstract) is applied to spin systems with Ising coupling. The partition function of the spin system is expressed in terms of the effective Hamiltonian H_e of a pair of neighbouring spins. In the ferromagnetic case, H_e contains only an effective Ising coupling term and an effective field term. In the antiferromagnetic case, H_e contains in addition a staggered effective field term. The constant coupling approximation which is obtained by assuming that the effective Ising coupling is constant is shown to be equivalent to the familiar quasi-chemical approximation. For an antiferromagnetic spin system with an external field of arbitrary magnitude in the preferred direction this approximation is worked out in detail. Both for the paramagnetic and for the antiferromagnetic phase the thermodynamic quantities of the system are obtained from a basic equation that is analogous to the Bethe–Peierls equation for the ferromagnetic case. The critical data are evaluated, and an explicit formula is derived for the critical curve in the B v. T plane. A.

538.22

6002. PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF A NATURAL CRYSTAL OF ILMENITE ($TiFeO_3$). H.Bizette and B.Tsaï.
C. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2124-7 (April 23, 1956). In French.

Reports results of measurements between 4°K and room temp. Susceptibility maxima occur at 68°K both parallel and perpendicular to the ternary axis. At room temp. the mass susceptibility is almost isotropic and equal to 92×10^{-6}. The results are discussed in relation to the crystal structure.
E.P.Wohlfarth

538.22

6003. MAGNETIC SUSCEPTIBILITY OF COPPER METAL AT LOW TEMPERATURES. R.Bowers.
Phys. Rev., Vol. 102, No. 6, 1486-8 (June 15, 1956).

The total magnetic susceptibility of high-purity copper has been measured between 300°K and 1.45°K using the Gouy method. It is found that the mass susceptibility can be represented by $\chi = (-0.083 + 0.023/T) \times 10^{-6}$ c.g.s. unit. This temperature dependence is much smaller than that found by previous workers, whose data extends only down to 14°K. An anomaly in the susceptibility at low temperatures, previously reported was not found. The nuclear susceptibility of copper is responsible for about one-fifth of the temperature dependence found in the present work; the remainder can be explained by a paramagnetic impurity content which is plausible for the particular copper used. It is concluded that the susceptibility o pure copper is substantially independent of temperature in t measured range.

538.22 : 548.7 : 537.226

PHYSICAL PROPERTIES OF SYNTHESIZED $FeTiO_3$ AN $NiTiO_3$ CERAMICS. See Abstr. 5072

538.2

6004. MAGNETIC PROPERTIES OF GADOLINIUM FERRITES. R.Pauthenet.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1859-62 (April 9, 1956). In French.

Reports results of magnetization measurements betwee 2° and 750°K on $Fe_2O_3.Gd_2O_3$ and $5Fe_2O_3.3Gd_2O_3$. The magne ization is given by $\sigma(H) = \sigma(0) + \chi H$, and the temperature variation of $\sigma(0)$ and $1/\chi$ was obtained. For $Fe_2O_3.Gd_2O_3$, $\sigma(0)$ is small and vanishes at 670°K; for $5Fe_2O_3.3Gd_2O_3$ ther is a compensation point at 290°K and a Curie point at 564°K For earlier work, see Abstr. 9382 (1954). E.P.Wohlfar

538.2

6005. EFFECT OF ALKALINE AND ALKALINE EARTH IONS ON THE INITIAL PERMEABILITY OF MANGANESE–ZINC FERRITES. C.Guillaud, B.Zega and G.Villers.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2312-15 (May 7, 1956). In French.

The initial permeability is found to increase initially wi increasing impurity content and then to reach a steady value The slope of the initial rise depends markedly on the ionic radius and the polarity of the impurity ions, both factors aff ing the internal strains in the material. E.P.Wohlfar

538.2

6006. MAGNETIC PROPERTIES OF $MnAu_4$. A.J.P.Meye
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2315-18 (May 7, 1956). In French.

Reports results of magnetic investigations on the face-centred tetragonal compound $\gamma'MnAu_4$, which suffers a phas change to face-centred cubic $\gamma MnAu_4$ at 400° C. The γ' com pound is ferromagnetic with Curie temperature 88° C, PB value 4.15 and Curie–Weiss paramagnetism with specific Curie constant 3.50×10^{-3}. The γ phase may be retained to room temperature by quenching, and its magnetic propertie were also studied. See also Kussmann and Raub, Zeitschrif für Metallkunde, Vol. 47, 9 (1956). E.P.Wohlfar

538.2

6007. MAGNETIC PROPERTIES OF A GADOLINIUM ORTHOFERRITE, $GdFeO_3$ CRYSTAL. M.A.Gilleo.
J. chem. Phys., Vol. 24, No. 6, 1239-43 (June, 1956).

$GdFeO_3$ in single crystal form exhibits magnetization b tween temperatures of 78 and 295°K which consists of a fiel independent part σ_0 and a field dependent part χH for fields above 6000 oersteds. The parasitic ferromagnetization σ_0 amounts to about 1% of the σ(Fe) available and may be attrib to imperfectly compensated antiferromagnetism of the Fe^{3+} ion sublattice. The susceptibility χ appears to be made up o paramagnetic contribution from the Gd^{3+} ion sublattice and a contribution from the antiferromagnetic Fe^{3+} ion sublattice influenced by interaction between the two sublattices. The anisotropy of σ_0 and χ changes with temperature. The maxi mum σ_0 and minimum χ do not coincide as they would if both took the direction of the antiferromagnetic axis of the Fe^{3+} ion sublattice.

538.2

6008. ON THE UNIAXIAL ANISOTROPY INDUCED BY MAGNETIC ANNEALING IN FERRITES. S.Taniguchi and M.Yamamoto.
J. Phys. Soc. Japan, Vol. 11, No. 5, 604 (May, 1956).

Interprets the magnitude and orientational dependence o the energy of anisotropy produced by the magnetic annealing

CoZn ferrite (Abstr. 498/1956) by considering the distribut- of the magnetic and non-magnetic ions or ion vacancies ong the available lattice sites and the dipole interaction, ich is anisotropic, between them. E.P.Wohlfarth

538.221 : 538.082

09. MAGNETIC MEASUREMENTS ON INDIVIDUAL CROSCOPIC FERRITE PARTICLES NEAR THE SINGLE-MAIN SIZE. A.H.Morrish and S.P.Yu.
ys. Rev., Vol. 102, No. 3, 670-3 (May 1, 1956).

A novel quartz-fibre torsion balance is employed to make gnetic measurements on individual microscopic ferrite par-les. A very direct experimental test provides strong evi-nce for the existence of single-domain magnetic particles. rther, the results confirm theoretical calculations of the itical single-domain size within a small factor. A.

538.221

10. MAGNETIC PROPERTIES OF COLLOIDAL NICKEL-S OXIDE. J.T.Richardson and W.O.Milligan.
ys. Rev., Vol. 102, No. 5, 1289-94 (June 1, 1956).

Magnetic susceptibility measurements by the Faraday thod have been made in the temperature range 4-550°K for series of iron-free nickelous oxide samples prepared by the at-treatment of hydrous nickelous hydroxide in a current of rogen at temperatures of 250-1300°C, the crystal size as ven by electron diffraction methods varying from 80-2000 A. mples (crystal size ~ 2000 A) prepared at 1200-1300°C hibit susceptibilities typical of an antiferromagnetic material, e observed Néel point of 523°K agreeing with the results of rlier investigators. In samples (crystal size ~ 100-200 A) epared at 300-500°C the susceptibility agrees with that for e larger crystals above the Néel point, but exhibit maxima lower temperatures. The temperatures, T_C, at which the xima appear, decrease regularly and the amplitudes of the xima increase regularly, with decreasing crystal size. In e range studied, linear plots [$10^{-4}T_C = 1.090f-1.037$] are ob-ned for T_C as a function of f, the ratio of the average num-r of next nearest magnetic neighbours per nickel atom to the mber of next nearest magnetic neighbours in an infinite crys-, as computed from the observed crystal sizes. Neutron dif-action patterns demonstrate that the magnetic structure is tiferromagnetic at temperatures both above and below T_C, d hence the maxima do not correspond to shifted Néel points. e magnetic susceptibility curves for the colloidal crystals of kelous oxide resemble those obtained by others for certain on and chromium sulphides. In iron sulphide, FeS_X, the sus-ptibility increase to the maximum is attributed by Néel and ers to a ferrimagnetic structure, analogous to certain fer-es. In view of the "active" oxygen (Bunsen test) contents of e nickelous oxide samples which vary from 0.36 to 0.00% as e crystal size increases from 80 to 2000 A, it is possible to ribute the ferrimagnetic behaviour to the ordering of a sub-ttice of defects, as Néel does for FeS_X. However, the subse-ent decrease in susceptibility at temperatures below T_C nnot be readily explained for either FeS_X or NiO. In view of e linear relationship between T_C and f, it is concluded that e unusual magnetic properties of colloidal nickelous oxide is ributable to the small size of the crystals and the accom-nying enhanced specific surface and the decreased number next nearest magnetic neighbours which results in an altered gnetic environment. Nickelous oxide prepared at 250°C con-ns a small amount of undecomposed nickelous hydroxide tectable by electron diffraction methods. The magnetic sus-ptibility of pure nickelous hydroxide follows a Curie–Weiss w $\chi m = 1.07/(T - 36)$ from about 300° to 90°K. Below 90°K, e susceptibility increases more slowly to a value of 2000 x 10^{-6} e.m.u. at 4°K, and some field dependence was served, suggesting the desirability of additional studies con-rning possible ferromagnetism. A.

538.221

11. DOMAIN STRUCTURE AS AFFECTED BY THE UNI-XIAL FERROMAGNETIC ANISOTROPY INDUCED IN CUBIC SOLID SOLUTIONS. M.Yamamoto, S.Taniguchi and K.Aoyagi.
Phys. Rev., Vol. 102, No. 5, 1295-7 (June 1, 1956).

The domain structure of a 40% cobalt-nickel single crystal has been found to be very small-scaled and complicated in the annealed state as compared with that of ordinary ferromagnetic substances but it becomes simpler and larger after quenching from above the Curie temperature, indicating that the domain structure of a cubic solid solution can be affected by the induced uniaxial anisotropy. It is shown that these findings, together with the results of considerations reported previously, lead to the conclusion that the Perminvar-type magnetic properties are due to the stabilization of domain walls by the induced uniaxial anisotropy in face-centred cubic solid solutions and in body-centred cubic solid solutions with negative cubic anisotropy constants. A.

538.221 : 548.74

6012. AN ANTIFERROMAGNETIC TRANSITION IN ZINC FERRITE. J.M.Hastings and L.M.Corliss.
Phys. Rev., Vol. 102, No. 6, 1460-3 (June 15, 1956).

Neutron powder diffraction patterns have been obtained for zinc ferrite over the temperature range 2.7°K-300°K. The data strongly suggest that the compound undergoes a transition from a paramagnetic state to an antiferromagnetic state in the neighbourhood of 9°K. Superlattice lines observed below this temperature can be indexed on a cubic unit cell whose edge is twice that of the chemical cell. A model consisting of an antiferromagnetic alternation of ferromagnetic "bands" is tentatively proposed and discussed in relation to the observed line intensities. A.

538.221

6013. NEW LOW-TEMPERATURE FERROMAGNETS. A.N.Holden, B.T.Matthias, P.W.Anderson and H.W.Lewis.
Phys. Rev., Vol. 102, No. 6, 1463 (June 15, 1956).

Certain of the complex cyanides of elements of the 3d transition group appear to be ferromagnetic at very low temperatures. A.

538.221 : 538.24

6014. ON POWDER PATTERNS AND MAGNETIZATION PROCESSES IN HIGH-COERCIVITY ALNICO MAGNETS. A.Kussmann and J.H.Wollenberger.
Z. angew. Phys., Vol. 8, No. 5, 213-16 (1956). In German.

Bitter patterns have been obtained on Alnico of high coercive force (670 oersted), which had been cooled in a magnetic field, and which was known to have a finely dispersed texture. The patterns consist of lines parallel to the preferred direction. A.E.De Barr

538.222

6015. FIELD DEPENDENCE OF ANTIFERROMAGNETIC SUSCEPTIBILITY. T.Nagamiya.
Physica, Vol. 22, No. 3, 249-51 (March, 1956)..

Reports results of calculations for a substance with orthorhombic crystal structure and makes comparison with measured values for powdered $CuCl_2.2H_2O$. E.P.Wohlfarth

538.222 : 535.338.332

6016. MAGNETIC RESONANCE IN THE $7\,^3S_1$ LEVEL OF MERCURY. J.Brossel and C.Julienne.
C.R. Acad. Sci. (Paris), Vol. 242, No. 17, 2127-9 (April 23, 1956). In French.

Hg and 6 mm pressure of N_2 are simultaneously irradiated with a Hg lamp and a strong r.f. field at 148.0 Mc/s. The ground $6\,^1S_0$ level absorbs 2537 A radiation to give the $6\,^3P_1$ which degrades by collision with N_2 to the metastable $6\,^3P_0$ level, which is able to absorb 4046 A radiation to give the $7\,^3S_1$ level. This emits radiation at 4046, 4358 and 5460 A and a change of the polarization properties of this emission occurs when the 148.0 Mc/s radiation causes spin transitions in the upper $7\,^3S_1$ level; the maximum effect occurs when a steady magnetic field of 52 gauss is applied to the system. D.H.Whiffen

538.222

6017. PARAMAGNETISM OF THE γ PHASE IN COPPER MANGANESE ALLOYS. H.P.Myers.
Canad. J. Phys., Vol. 34, No. 6, 527-34 (June, 1956).

Measurements of the paramagnetic susceptibility and its variation with temperature were made on a series of copper manganese alloys having compositions from 10 to 90 atomic % manganese. The measurements were confined to the temperate regions where the face-centred cubic γ phase is known to be stable. The results show that alloys containing < 25 atomic % manganese present a Curie–Weiss dependence of suceptibility on temperature, in agreement with earlier work. For compositions between 30 and 40 atomic % manganese the $1/\chi$ v. T graph is linear at high temperatures but becomes increasingly curved at lower temperatures, the curvature being concave to the temperature axis. Alloys containing more than 60 atomic % manganese show a linear variation of $1/\chi$ with temperature but the change in χ, both with temperature and with composition, is slight. Alloys with 70 and 80 atomic % manganese show minima in the susceptibility at 900° and 950° C respectively. An alloy with 90 atomic % manganese showed a continuous increase of susceptibility with temperature. A.

538.222

6018. PARAMAGNETIC FINE STRUCTURE SPECTRUM OF Cr^{+++} IN A SINGLE RUBY CRYSTAL. J.E.Geusic.
Phys. Rev., Vol. 102, No. 5, 1252-3 (June 1, 1956).

The fine structure spectrum of the Cr^{+++} paramagnetic resonance line in a single ruby crystal has been studied at 300° K. From the measurements it is found that the zero-field splitting of the spin levels is $2(0.193 \pm 0.001)$ cm^{-1} and the spectroscopic splitting factors are $g_{\parallel} = 2.003 \pm 0.006$ and $g_{\perp} = 2.00 \pm 0.02$. A.

538.222

6019. ELECTRON AND NUCLEAR SPIN RESONANCE AND MAGNETIC SUSCEPTIBILITY EXPERIMENTS ON DILUTE ALLOYS OF Mn IN Cu. J.Owen, M.Browne, W.D.Knight and C.Kittel.
Phys. Rev., Vol. 102, No. 6, 1501-7 (June 15, 1956).

Dilute alloys of Mn in Cu are expected to show marked effects of the exchange interaction between the $3d^5$ ion core electrons of the Mn atoms and the 4s conduction electrons of the crystal. The simple model leads to the prediction of indirect exchange ferromagnetism; electronic Knight shift of the electron spin resonance line - nuclear Knight shift of the copper nuclear resonance; electron spin relaxation by the coupling with the conduction electrons; and a contribution to the electrical resistivity by the Elliott–Schmitt mechanism. The observed width of the electron spin resonance line suggests that the sd exchange interaction may be of the order of 0.2 of the interaction in the free ion. The dilute alloys appear to be antiferromagnetic, but with a ferromagnetic interaction also present which is rather stronger than calculated on the indirect exchange model. An unexpected experimental result is that the nuclear Knight shift is unaffected by the presence of Mn, suggesting that the conduction electron magnetization by the sd coupling is less than 1/50 of what might be expected. A.

538.222

6020. REMARKS ON RECENT MEASUREMENTS OF THE PARAMAGNETIC EFFECT IN TIN. H.Meissner.
Phys. Rev., Vol. 103, No. 1, 39-40 (July 1, 1956).

It is shown that the measurements of Shibuya and Tanuma substantiate rather than invalidate the statement that the maximum permeability in the paramagnetic effect occurs for given values of the current I and the external field H at a temperature where the total magnetic field at the surface of the sample is equal to the critical field. It is further shown that their new equations, $I_0 = \xi\gamma^* d(T_C - T)/4$ and $H_0 = \xi(T_C - T) - 4I_g/\gamma^* d$, follow as a first approximation from the statement that the maximum permeability depends only on $\gamma = 4(I - I_g)/Hd$. A.

538.222 : 539.15

6021. HYPERFINE STRUCTURE OF PARAMAGNETIC RESONANCE IN COPPER TUTTON SALTS AT INTERMEDIATE FIELDS. N.S.Garif'yanov and M.M.Zarinov.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 629-30 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 567-8 (Nov., 1955).

Measurement of the electron spin resonance of a single crystal of $CuK_2(SO_4)_2.6H_2O$ diluted witht the Zn salt at 526.74 Mc/s and at liquid air temperatures was consistent with a spin Hamiltonian with the parameters $A = -8.3 \times 10^{-3}$ cm^{-1}, $B = 4.5 \times 10^{-3}$ cm^{-1}; $Q = 1 \times 10^{-3}$ cm^{-1}; $g_{\parallel} = 2.47$ and $g_{\perp} = 2.0$ These differ slightly from the values at 20° K (Abstr. 9605/1951). D.H.Whiffen

538.22

6022. THE PROBLEM OF THE COEXISTENCE OF THE QUANTUM MECHANICAL AND CLASSICAL TREATMENTS OF ANOMALOUS DIAMAGNETISM. A.Knappwost.
Naturwissenschaften, Vol. 43, No. 8, 176 (1956). In German.

Reports results of measurements of the diamagnetic susceptibility χ of several graphite specimens having differen crystal grain sizes d, and finds $\chi \propto d^n$ where $n < 1$, supporting the quantum mechanical rather than the classical treatment according to which n is ~ 2. For independent earlier measurements see Abstr. 4732, 8433 (1954), 2893 (1955). E.P.Wohlfarth

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3 : 532.5

6023. THE EQUILIBRIUM OF A SELF-GRAVITATING INCOMPRESSIBLE FLUID SPHERE WITH A MAGNETIC FIELD. I. K.H.Prendergast.
Astrophys. J., Vol. 123, No. 3, 498-508 (May, 1956).

It is shown that the introduction of a toroidal, as well as poloidal, field makes possible an exact solution of the equatio of hydromagnetic equilibrium. A

538.

6024. THE EXTERNAL ELECTRIC FIELD OF A ROTATIN MAGNET. G.Backus.
Astrophys. J., Vol. 123, No. 3, 508-13 (May, 1956).

The electromagnetic fields outside rigidly rotating magnets in vacuum are computed in two cases: for a nonconducti magnet with dielectric constant unity the electric and magneti fields are given exactly in terms of retarded potentials; for a conducting magnet the electric and magnetic fields are computed in the region of space where the displacement current can be neglected. In the former case the rotation of the magnet has no effect unless its stationary magnetic field is axiall asymmetric. One example of the latter case is that a uniform magnetized conducting sphere rotating about its axis of magne ization produces an external electric quadrupole field. These results contradict Alfvén's results for the same problem but agree with the experimental results he cites in favour of his theory. A

538.3

6025. THE FUNDAMENTAL EQUATIONS OF A NON-CONSERVATIVE CLASSICAL ELECTROMAGNETISM. É.Durand.
C. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1862-5 (April 9, 1956). In French.

A physical interpretation is given of the quantities appear ing in the generalization of Maxwell's equations previously given by the author (Abstr. 158/1948) to include creation and annihilation of electric and magnetic charges. It is shown in particular that the creation field is directly connected to the output of the sources. L.Pincherl

538.3 : 530.12

026. THE CALCULATION OF ELECTROMAGNETIC ENTITIES IN ELECTRIC CIRCUITS BY MEANS OF RELA-IVISTIC ELECTRODYNAMICS. V.Kreisinger.
lektrotech. Obzor, Vol. 43, No. 12, 617-21 (1954). In Czech.

The characteristics of an electric circuit can be estab-shed by the application of Maxwell's equations and Ohm's law a vectorial form, on the assumption that the resultant force cting on a body, which is stationary within an inertial system coordinates, equals zero. The equations of motion of a de-ched charge in stationary vacuum are established. The iden-ties of potential and intensity are then calculated for a con-uctor moving through an electrically and magnetically defined eld. This process is also applied to a loop-type conductor nd to a series of such loops with different relative velocities. he calculations are further extended to conductors in ferro-agnetic media. J.C.Stark

538.3 : 517.3

027. ON A METHOD OF INTEGRATING MAXWELL'S QUATIONS. R.Vallée.
nde élect., Vol. 36, 122-33 (Feb., 1956). In French.

First a theorem on necessary and sufficient conditions for ne existence of an integrating method in vector fields is stated nd proved. Maxwell's equations are obtained in a suitable orm by means of Heaviside's method and the above theorem, nd the integration is also demonstrated in the cases of trans-erse waves, spherical transverse waves, and spherical non-ransverse waves. A list of the solutions is given. The sec-nd part of the paper contains the determination of the electro-agnetic waves emitted by a portion of a rectilinear conductor the form of a wire isolated in space. A.V.Payne

538.3

028. ON THE STABILITY OF THE EQUILIBRIUM CON-GURATIONS OF A WIRE CARRYING A CURRENT IN A AGNETIC FIELD. C.Bernardini.
C. Accad. Naz. Lincei, Vol. 19, No. 5, 297-301 (Nov., 1955). Italian.

These configurations, when weight, rigidity and self-eld of the wire can be neglected, give the trajectories of arged particles in the same magnetic field (floating wire ethod). In the case of a focusing field, infinite trajectories e possible, and correspondingly the equilibrium configura-on of the wire is unstable. In the present paper the existence instability is proved for the case when all the configurations e in one plane. L.Pincherle

538.52

029. EFFECTS OF ELECTROMAGNETIC INDUCTION. NIPOLAR INDUCTION. G.Vallauri.
ubbl. Ist. Elettrotec. Naz. Ferraris, No. 405, 31 pp. (1955). Italian.

A discussion of the interpretation of the electric field roduced by a cylindrical permanent magnet rotating about its xis. The correct interpretation is suggested by the symmetry etween electricity and magnetism, and must be based on a icture of individual magnetic charges. L.Pincherle

538.522 : 621.3.011.32

030. THE MEAN GEOMETRICAL DISTANCES OF NNULAR CROSS-SECTIONS. H.Shering.
lektrotech. Z. (ETZ) A, Vol. 77, No. 1, 12-13 (Jan. 1, 1956). German.

By applying Maxwell's equations to a cross-section of a ollow cylindrical conductor and developing the resulting ex-ression into a series of which the first few terms give a suf-cient approximation, simple formulae are established giving ne mean geometrical distance and the value of the inductance er unit length of a pair of co-axial conductors. A.Karlsbad

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56

6031. ON THE PROPAGATION OF PLANE WAVES IN A CONDUCTOR IN MOTION. A.M.Manarini.
R.C. Accad. Naz. Lincei, Vol. 20, No. 2, 229-31 (Feb., 1956). In Italian.

538.56 : 532.51

6032. ON THE THEORY OF MAGNETOHYDRODYNAMIC WAVES. E.Richter.
Z. Naturforsch., Vol. 11a, No. 3, 251 (1956). In German.

It is reported that solutions of the linearized equations can be obtained without neglecting displacement currents when all field quantities are functions of time and a single spatial coordinate. R.A.Newing

538.561

6033. PLASMA-ELECTRON OSCILLATIONS. R.A.Bailey and K.G.Emeleus.
Proc. Roy. Irish Acad. A, Vol. 57, No. 5, 53-62 (May, 1955).

An experimental investigation on the electric discharge near a hot cathode in Hg vapour at 10^{-3} mm Hg pressure. Oscillations with about the plasma frequency were observed, but with a complicated and somewhat variable pattern, partly due to reflection of electrons from the tube walls. At low currents a layer of plasma marks the boundary between regular and highly disturbed movement. With larger currents the layer becomes blurred and low-frequency (ionic) oscillations appear. Steady oscillations can then be maintained by applying a magnetic field parallel to the primary beam. It is concluded that there is probably no exact analogy between oscillations in plasmas and those in conventional circuits including vacuum tubes. L.Pincherle

538.566 : 621.371 : 621.396.67

6034. EXPERIMENTAL STUDY OF THE DIFFRACTION OF MICROWAVES BY APERTURES WITH ROTATIONAL SYMMETRY. E.Boivin, A.Dion and H.P.Koenig.
Canad. J. Phys., Vol. 34, No. 2, 166-78 (Feb., 1956). In French.

The apertures studied are circular, annular and the Soret group of annuli. The results show that calculations of Fresnel diffraction based on Kirchhoff's approximation are accurate to better than 5% for planes as near to the screen as two diameters. For the Soret cluster it was observed that when the centre is opaque the resolution is greater than for the circular aperture and when the centre is clear the resolution is less. Many curves are plotted for measurements of both polarizations on and off the axis and compared with the Lommel calculations. As source a 2K33 klystron is used at 1.25 cm, modulated at 1000 c/s. The diffracted wave is picked up on a $\lambda/2$ dipole moved automatically by a traversing mechanism. Recording is automatic. To prevent errors due to stray reflections steel wool is strategically disposed as an absorbing material. S.C.Dunn (R)

538.566

6035. DIFFRACTION OF 3.2 cm ELECTROMAGNETIC WAVES BY DIELECTRIC RODS. I. LUCITE AND TENITE 1 in. DIAMETER CYLINDERS. M.K.Subbarao and A.B.McLay.
Canad. J. Phys., Vol. 34, No. 6, 546-54 (June, 1956).

Diffraction patterns of lucite and tenite cylindrical rods of approximately one inch diameter, in a nearly plane beam of square-wave modulated 3.2 cm waves with electric vector parallel to the cylinder axis, have been measured in several planes transverse to the incident beam direction. Patterns are compared with theoretical ones (Froese and Wait 1954) and with ones obtained earlier, under similar experimental conditions, for brass and hard rubber cylinders (Wiles and McLay 1954). Some general marked trends in the patterns of the four rods, comprising a conductor, two nearly lossless dielectrics

with different dielectric constants, and a lossier dielectric, are related to the effects of transmission and/or surface reflection expected from geometrical optics considerations. A.

538.566

6036. DIFFRACTION OF 3.2 cm ELECTROMAGNETIC WAVES BY DIELECTRIC RODS. II. LUCITE $1\frac{1}{2}$ in. DIAMETER CYLINDER AND SEMICYLINDERS. A.B.McLay and M.K.Subbarao.
Canad. J. Phys., Vol. 34, No. 6, 555-62 (June, 1956).

Diffraction patterns of a lucite cylinder and a half cylinder in a nearly plane beam of square-wave modulated 3.2 cm waves, with electric vector parallel to the cylinder axis, have been measured in several planes transverse to the incident beam direction. Patterns of the half cylinder were obtained with the plane face toward and away from the source of radiation. Marked trends in the patterns are related qualitatively to the effects of transmission and surface reflection, both external and internal, expected from geometrical optics considerations. A.

538.566.2 : 621.396.11

6037. PROPAGATION OF AUDIO-FREQUENCY RADIO WAVES TO GREAT DISTANCES. F.W.Chapman and R.C.V.Macario.
Nature (London), Vol. 177, 930-3 (May 19, 1956).

Experiments on the propagation of atmospherics have suggested that below about 12 kc/s the Austin–Cohen law does not hold. The results appear to agree with the waveguide theory of Budden (Abstr. 7804/1953). J.M.Hough

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

6038. SOLID STATE PHYSICS. ADVANCES IN RESEARCH AND APPLICATION. VOLUME I. Edited by F.Seitz and D.Turnbull.
New York: Academic Press (1955) xii + 469 pp.

Review in Brit. J. appl. Phys., Vol. 7, No. 5, 197-8 (May, 1956). The articles in this volume are: "Methods of the one-electron theory of solids" by J.R.Reitz, "Qualitative analysis of the cohesion in metals" by E.P.Wigner and F.Seitz, "The quantum defect method" by F.S.Ham, "The theory of order–disorder transitions in metals" by T.Muto and Y.Takagi, "Valence semi-conductors, germanium and silicon" by H.Y.Fan, "Electron interaction in metals" by D.Pines.

539.11

6039. STATISTICAL FLUCTUATIONS IN A CONDENSING SYSTEM. M.Fierz.
Helv. phys. Acta., Vol. 29, No. 1, 47-54 (March, 1956). In German.

Discusses the density fluctuations for the spherical model of a ferromagnet and for a Bose–Einstein gas in the neighbourhood of the critical points. E.P.Wohlfarth

539.11

6040. THE BAND STRUCTURE OF MIXED LINEAR LATTICES. E.H.Kerner.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 234-44 (March, 1956).

A reformulation of Saxon and Hutner's scattering matrix method for lattices is introduced, and a connection shown between the characteristic matrix for going across a cell in the lattice and proper Lorentz transformations. This provides a convenient geometrical model for analysing mixed lattices of A and B atoms. Luttinger's proof of a theorem on the persistence of forbiddenness, in the mixed lattice, of energies forbidden in the pure component lattices is generalized. It is shown also that there are energy levels in mixed lattices whose forbidden or allowed character is invariant to any re-arrangement of lattice atoms, and that there are physically distinguishable lattices having identical band structures. The major problem of finding the probability that a given energy is allowed or forbidden in a random mixed lattice is taken up. A method for finding the moments of the relevant random variable is provided, and the complete analysis for the Poisson limit of a few B atoms sprinkled in a long A lattice is given, with quantitative conclusions as to the persistence of allowedness in mixed lattices, the effect of strong forbiddenness in the pure lattice on the band structure of the mixed lattice, and the like. A.

539.11

6041. COMPARISON OF LOCALIZED FUNCTIONS AND PLANE WAVES FOR ELECTRONS WITH INTERACTION. H.A.Weidenmüller.
Z. Phys., Vol. 145, No. 1, 54-64 (1956). In German.

The two types of wave function are used to calculate the ground state energy of a linear metal, for a Gaussian interaction potential and for parallel as well as antiparallel spins. E.H.Sondheimer

539.11

6042. ELECTRON THEORETICAL INVESTIGATIONS OF DEFECTS IN METALS. II. THE BINDING ENERGY OF VACANCY PAIRS IN MONOVALENT AND TRANSITION METALS. A.Seeger and H.Bross.
Z. Phys., Vol. 145, No. 2, 161-83 (1956). In German.

For Pt I see Abstr. 4537 (1956). Reports results of a calculation of the binding energy of two neighbouring lattice vacancies assuming a potential field having spheroidal symmetry. For monovalent metals the energy per vacancy is about 0.3 eV. E.P.Wohlfarth

539.11 : 538.114

ORDERING AND ANTIFERROMAGNETISM IN FERRITES. See Abstr. 5207

MOLECULES 539.13

539.13 : 535.32

THE THEORY OF THE REFRACTIVE INDEX OF NON-POLAR GASES. See Abstr. 4976

539.13

6043. FORCE CONSTANTS FOR SUBSTITUTED GERMANES. II. $GeCl_3H$ AND $GeCl_4$. S.L.N.G.Krishnamachari.
Indian J. Phys., Vol. 29, No. 8, 384-7 (Aug., 1955).

For Pt I, see Abstr. 8956 (1955). Force constants are calculated for $GeCl_3H$ and $GeCl_4$ using the Wilson F-G matrix method. A comparison is made between the force constants which are common for the three molecules GeH_3Cl, $GeCl_3H$ and $GeCl_4$. The agreement between $GeCl_3H$ and $GeCl_4$ is found to be better than that between $GeCl_3H$ and GeH_3Cl. A

539.132

6044. COMMENTS ON THE NUMERICAL EVALUATION OF MOLECULAR INTEGRALS FOR SMALL INTERNUCLEAR DISTANCES. II. W.Bingel.
Z. Naturforsch., Vol. 11a, No. 3, 186-92 (1956). In German.

See Abstr. 3058 (1956). The nuclear attraction integrals $K\alpha\beta$ were expressed earlier in terms of auxiliary functions C_n, and are now extended, for the second atom b need not be situated on the axis of the one electron functions of atom a. The new formulation simplifies also the computation of sums of integrals of this kind for molecules with several outer atoms b placed around a central a. J.Jacobs

539.132

)45. MASS ASYMMETRY EFFECT IN HUTCHISSON'S HEORY OF VIBRATIONAL TRANSITION PROBABILITIES. .R.Tawde and P.V.Chandratreya.
dian J. Phys., Vol. 29, No. 8, 388-92 (Aug., 1955).

Even though Hutchisson's theory of vibrational transition robabilities in diatomic molecules assumed the symmetry of nstituent atomic masses, it was generally considered valid r asymmetric molecules too. Attempt has been made to examine this validity for some highly asymmetric molecules. It concluded from the study of some band systems of BO, AlO, iO and VO that considerable departures from theory result ith increase in mass asymmetry. A.

539.132

046. AN APPROXIMATE METHOD OF CALCULATING HE VIBRATION FREQUENCIES OF 1, 1, 1-TRICHLOROTHANE MOLECULE. D.C.Biswas.
idian J. Phys., Vol. 29, No. 9, 446-9 (Sept., 1955).

It has been shown that when the 1, 1, 1-trichloroethane olecule is divided into two parts and the vibration frequencies re calculated under certain assumptions for these two parts, ese frequencies agree with those calculated for the whole olecule by the accurate method. It is pointed out that this pproximate method is simpler and less time-consuming than e elaborate one while the discrepancies in the results obined by this approximate method are quite negligible. A.

539.132

6047. VIBRATION-ROTATION INTERACTION IN POLYATOMIC MOLECULES. I. THE ZETA MATRICES. J.H.Meal nd S.R.Polo.
. chem. Phys., Vol. 24, No. 6, 1119-25 (June, 1956).

Some properties of the zeta matrices which simplify the nalytical treatment of vibration-rotation interaction are given. Methods of obtaining relationships among the zeta elements hich depend only on the atomic masses and geometry of the olecule are outlined and some examples are discussed. Symetry arguments are introduced to simplify the results further. A.

539.132

6048. VIBRATION-ROTATION INTERACTION IN POLYATOMIC MOLECULES. II. THE DETERMINATION OF CORIOLIS COUPLING COEFFICIENTS. J.H.Meal and S.R.Polo.
. chem. Phys., Vol. 24, No. 6, 1126-33 (June, 1956).

A general method for the analytical treatment of vibration-otation interaction in polyatomic molecules is presented. The nethod is especially adapted to carry out the calculation of the Coriolis coupling coefficients along with the normal coordinate reatment in terms of any chosen set of internal coordinates. The relations existing among the ζ elements and the potential constants are established in a general and convenient form. Particular attention is given to symmetric top molecules, and he effect of vibration-rotation interaction on band structure s discussed. Approximate methods for the calculation of zeta alues are considered also. A.

539.132

6049. MATRICES D^{-1} AND G^{-1} IN THE THEORY OF MOLECULAR VIBRATIONS. S.R.Polo.
J. chem. Phys., Vol. 24, No. 6, 1133-8 (June, 1956).

A vector method to determine the elements of the matrices D^{-1} and G^{-1}, used in the vibrational analysis of polyatomic molecules is presented. Examples are given to illustrate the method. A.

539.132

6050. HIGHER ORDER ROTATION-VIBRATION ENERGIES OF POLYATOMIC MOLECULES. I. M.Goldsmith, G.Amat nd H.H.Nielsen.
. chem. Phys., Vol. 24, No. 6, 1178-82 (June, 1956).

As a prerequisite for the evaluation of third- and fourth-rder perturbation energies of a rotating-vibrating polyatomic molecule, an appropriate Schroedinger equation is derived and a preliminary discussion given of a useful contact transformation of the Hamiltonian. A.

539.132 : 535.343

6051. 9.6-MICRON BAND OF TELLURIC OZONE AND ITS ROTATIONAL ANALYSIS. L.D.Kaplan, M.V.Migeotte and L.Neven.
J. chem. Phys., Vol. 24, No. 6, 1183-5 (June, 1956).

The 9.6 μ band of atmospheric ozone has been investigated by means of high resolution measurements of the solar spectrum from the Jungfraujoch in Switzerland. A rotational analysis confirms its assignment as the ν_3 fundamental and results in the following values for the vibrational frequency and rotational constants: $\nu_3 = 1042.1_6$ cm^{-1}; $A = 3.50_2$ cm^{-1}, $B = 0.440_1$ cm^{-1}, $C = 0.388_3$ cm^{-1}. The decrease of all three rotational constants relative to the ground state values suggest an appreciable Coriolis interaction with the ν_1 fundamental. A.

539.132

6052. r-CENTROIDS: AVERAGE INTERNUCLEAR SEPARATIONS ASSOCIATED WITH MOLECULAR BANDS. R.W.Nicholls and W.R.Jarmain.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 253-64 (March, 1956).

The r-centroid $\bar{r}_{v'v''}$ of a molecular band is defined by

$$\int \Psi_{v'} r \Psi_{v''} dr \Big/ \int \Psi_{v'} \Psi_{v''} dr$$

and is an average internuclear separation which may be associated with the $v' \rightarrow v''$ transition. $\Psi_{v'}$ and $\Psi_{v''}$ are vibrational wave-functions. The physical meaning of r-centroids is discussed and it is shown that the average internuclear separation $\bar{r}_{v'}$ in the level v' may be represented by the weighted mean of r-centroids with respect to Franck-Condon factors $q_{v'v''}$; i.e. $\bar{r}_{v'} = \Sigma_{v''} q_{v'v''} \bar{r}_{v'v''}$. Methods for evaluating arrays of r-centroids are developed and values are reported for ten band systems. The smooth relationship between r-centroid and wavelength is described and illustrated. A knowledge of r-centroids has been found very useful in the discussion of variation with internuclear separation of the electronic transition moment and it may reasonably be expected to have value in the study of other molecular properties. A.

539.132

6053. COMMENTS ON THE PAPER: "THE GROUND STATE OF THE HYDROGEN MOLECULE". B.Kockel.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 236-7 (1956). In German.

See Abstr. 3933 (1955). A mistake in the normalization integrals of the eigenfunction Ψ_7 is reported and its effect on bond energies is discussed. J.Jacobs

539.132

6054. THE INTENSITIES OF THE SYMMETRY-FORBIDDEN ELECTRONIC BANDS OF BENZENE. J.N.Murrell and J.A.Pople.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 245-52 (March, 1956).

The molecular orbital method is used to calculate the intensities of the symmetry-forbidden bands of benzene. Both the bands at 2650 A and 2000 A derive intensity by interaction with the upper state of the 1800 A band. The states of symmetry B_{1u} and B_{2u} are made accessible by e_{2g} vibrations of the benzene framework at 606 cm^{-1} and 1595 cm^{-1}. The 606 cm^{-1} vibration is most important in making the transition to the B_{2u} state (at 2650 A) allowed, whereas that at 1595 cm^{-1} is most important for the $A_{1g} \rightarrow B_{1u}$ transition. The alternative assignments B_{1u} and E_{2g} are considered for the 2000 A band, but the calculated total intensities cannot differentiate between them. A.

539.132 : 537.561

IONIZATION POTENTIALS OF AMMONIA AND THE EXCITED STATES OF THE NH_3^+ ION. See Abstr. 5185

PA

539.132

6055. NUCLEAR QUADRUPOLE RESONANCE SPECTRUM OF B^{11} IN KERNITE. R.R.Haering and G.M.Volkoff.
Canad. J. Phys., Vol. 34, No. 6, 577-85 (June, 1956).

The pure quadrupole resonance frequencies of B^{11} nuclei at two different sites (denoted by E and F) in a single crystal of kernite ($Na_2B_4O_7.4H_2O$) have been determined both by observing the B^{11} resonances in zero external magnetic field, and also by investigating their Zeeman splitting in magnetic fields up to 30 gauss. The values obtained are 1281.1 ± 2 and 1287.0 ± 1 kc/s for the E and F sites respectively. These frequencies agree within experimental error with the values 1286 ± 4 and 1287 ± 3 kc/s predicted on the basis of studies in a magnetic field of 7000 gauss. The agreement for the F site is much better than for the E site. These zero field resonances have also been observed in a polycrystalline sample. The observed weak field Zeeman splitting for the single crystal agrees very well with that calculated from high field data for F sites, but at present disagrees with the corresponding calculation for E sites. A Na^{23} pure quadrupole resonance in kernite has also been measured at 1560.0 ± 1 kc/s. The second Na^{23} resonance expected from high field work has not been observed to date. A.

539.132

6056. ON THE PI-ELECTRON APPROXIMATION AND ITS POSSIBLE REFINEMENT. P.G.Lykos and R.G.Parr.
J. chem. Phys., Vol. 24, No. 6, 1166-73 (June, 1956).

The pi-electron approximation is defined as the approximation in which the following two restrictions are imposed upon the total approximate electronic wave-functions for some group of molecular states: (I) The wave-function for each state satisfies the sigma-pi separability conditions: (A) the wave-function has the form $\Psi = [(\Sigma)(\Pi)]$, where (Σ) and (Π) are antisymmetrized functions describing the so-called sigma and pi electrons, respectively, and the outer brackets connote antisymmetrization with respect to sigma-pi exchange; (B) each of (Σ), (Π) and Ψ is normalized to unity; (C) each of (Σ), (Π) and Ψ is well-behaved. (II) The sigma description is the same for all states. Imposition of these restrictions is shown to be sufficient to validate the customary procedure in which the pi electrons in a molecule are treated apart from the rest. A formula is given for the pi-electron Hamiltonian to be used when the pi-electron approximation is invoked. Present day pi-electron theories are examined, and lines for carrying out improved calculations are suggested. An iterative procedure is proposed for treating both sigma and pi electrons wherein first a sigma function is assumed (which defines a "core" in the field of which the pi electrons move), then a pi function is computed (which defines a "peel" in the field of which the sigma electrons move), then a new sigma function is computed, and so on. Certain generalizations of the quantum-mechanical argument are made which give it wider applicability, and several illustrations are drawn from pi-electron theory and elsewhere. A.

539.132

6057. DOUBLET STATES OF BENZYL RADICAL. Y.Mori.
J. chem. Phys., Vol. 24, No. 6, 1253 (June, 1956).

An approximate semi-empirical estimation of the excited states, treated as benzene states perturbed by ~~CH_2~~. The lowest transitions predicted agree moderately well with experiment and MO theory (Abstr. 8968/1955). J.Hawgood

539.132

6058. COMPARISON OF SCFMO AND ASMOCI CALCULATIONS OF ELECTRON DENSITIES. R.D.Brown and A.Penfold.
J. chem. Phys., Vol. 24, No. 6, 1259-60 (June, 1956).

Reports results of semi-empirical calculations on 2-centre π-electron models of $CH_2 = NH$, $CH_2 = NH_2^+$ and $CH_2 = N^-$, comparing results of an SCF LCAO one-configuration approach and a three-configuration LCAO approach, both using the approximation of zero differential overlap. The two methods agree well. J.Hawgoo

539.13

6059. ELECTRONIC STRUCTURE OF FERROCENE. M.Yamazaki.
J. chem. Phys., Vol. 24, No. 6, 1260-1 (June, 1956).

Describes a semi-empirical 18-electron SCFMO calculation on the "sandwich" molecule $Fe(C_5H_5)_2$. Predictions ar that the ground state is closed-shell, with 38% ionic Fe-C bonding, and with nearly free internal rotation of the C_5H_5 rings, and that the lowest transitions are 0.9, 2.5 and 3.7 eV experimentally, 2.82 and 3.43 eV. J.Hawgoo

539.13

6060. APPROXIMATE MOLECULAR ORBITALS. IV. THE $3p\sigma_u$ AND $4f\sigma_u$ STATES OF H_2^+. A.Dalgarno and J.T.Lewis.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 285-92 (April, 1956).

For Pt III, see Abstr. 8142 (1955). A variational method is used to obtain approximate wave-functions for the $3p\sigma_u$ and $4f\sigma_u$ states of H_2^+ and their accuracy is assessed by comparing various quantities computed using them with the exact values of these quantities. The dependence of the kinetic and potenti energies on the nuclear separation is discussed. A brief summary of the conclusions of this series of papers is presented. A

539.132 : 539.153.

6061. THE DENSITY MATRIX IN SELF-CONSISTENT FIELD THEORY. I. ITERATIVE CONSTRUCTION OF THE DENSITY MATRIX. R.McWeeny.
Proc. Roy. Soc. A, Vol. 235, 496-509 (June 19, 1956).

The approximate self-consistent field equations of Roothaan (1951) are studied from the standpoint of density ma rix theory. Their direct solution, which entails repeated determination of the individual occupied orbitals, is shown to b quite unnecessary. All information about the system under consideration can be obtained in terms of a one-particle density matrix; and this can be constructed by an iterative metho which involves only matrix algebra. As an illustration of the method, the ground state of the beryllium atom is calculated. The solution, which is approximated in a basis of four Slater functions, surpasses in accuracy all other analytical one-determinant wave-functions so far available, with one exception (Holtien, Abstr. 5589/1955). And although it approaches the accurate solution of the Hartree–Fock equations the com putation required is relatively small. Extensions of the meth od, in order to admit configuration-interaction calculations, are also discussed. An appendix introduces a "steepest descent" method of solving eigenvalence problems, which may b regarded as the prototype of the iterative construction described in the paper. A

539.132 : 535.34

ABSORPTION SPECTRA AND IONIZATION POTENTIAL OF BENZENE AND BENZENE-d_6. Abstr. 4993

539.13

6062. THE CALCULATION OF DIPOLE MOMENTS FROM MEASUREMENTS ON DILUTE SOLUTIONS. J.Czekalla.
Z. Elektrochem., Vol. 60, No. 2, 145-7 (1956). In German.

It is shown how the various methods for using the Clausius–Mosotti relation can be generalized and in fact are really physically identical. It is shown in particular how the simple Guggenheim–Smith formula can be used to advantage making only one physical assumption. T.C.Toy

539.13

6063. DIPOLE MOMENT OF INDENE. D.V.G.L.Narasimh Rao.
Indian J. Phys., Vol. 29, No. 8, 398-402 (Aug., 1955).

The dipole moment of indene is determined in three non-

polar solvents (cyclohexane, CCl_4 and CS_2) covering a dielectric constant range of about 2.0 to 2.6. The experimental observations are treated in the manner of Guggenheim for obtaining the dipole moment values. The high value of about 0.85 D obtained for the moment of the compound is suggested as probably arising out of the resonance of the molecule between various structures as in the case of the related compounds cyclopentadiene and fluorene. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

6064. INFORMATION ON ENERGY LEVELS IN Be^8 FROM NEUTRON ENERGY SPECTRA. J.R.Bird and R.H.Spear.
Austral. J. Phys., Vol. 8, No. 4, 567-72 (Dec., 1955).

The neutron energy spectrum from the bombardment of separated Li^7 with 920 keV deuterons has been measured, using nuclear emulsions as detectors. Conclusive evidence was obtained only for the ground-state and 2.9 MeV levels of Be^8, although, in contrast to most earlier experiments, the energy resolution achieved was adequate to resolve the "fine structure" reported by Catala et al. (Abstr. 758/1954). Factors influencing the energy resolution are discussed. Taking all earlier experiments into account, the existence of further levels at 4.1, 5.3 and 7.5 MeV is considered probable.
J.J.Wilkins

539.152.1

6065. A NEUTRON–PROTON POTENTIAL AND THE CAPTURE OF THERMAL NEUTRONS BY PROTONS. K.Chadan.
C. R. Acad. Sci. (Paris), Vol. 242, No. 16, 1964-6 (April 16, 1956). In French.

A triplet central potential is deduced for the neutron–proton system, based on the effective range approximation for the S phase shift, and the total capture cross-section for thermal neutrons by protons. P.T.Matthews

539.152.1

6066. COLLECTIVE OSCILLATIONS OF A SHELL STRUCTURE OF PARTICLES. A.Mouhasseb.
C.R. Acad. Sci. (Paris), Vol. 242, No. 17, 2111-14 (April 23, 1956). In French.

The adiabatic approximation is applied to the motion of a particle in an average field of slowly varying shape, to compare the collective Hamiltonian, proposed by A.Bohr, with that which can be deduced from the shell model.
P.T.Matthews

539.152.1

6067. LOWEST STATES OF PARTICLE EXCITATION IN EVEN–EVEN NUCLEI. R.Thieberger and I.Talmi.
Phys. Rev., Vol. 102, No. 3, 923-5 (May 1, 1956).

The first excited states of even–even nuclei near the magic numbers are interpreted, on the basis of the shell model, as due to particle excitation. They are calculated for those cases where two nucleons lie outside, (or are missing from), a closed shell, assuming jj coupling configurations and harmonic oscillator wave functions. Good agreement is obtained for pure Wigner force. P.T.Matthews

539.152.1

6068. TENSOR OPERATOR METHODS AND THE TWO-BODY SPIN–ORBIT INTERACTION. J.Hope and L.W.Longdon.
Phys. Rev., Vol. 102, No. 4, 1124-9 (May 15, 1956).

Assuming LS coupling, tensor operator methods are used to derive matrix elements of a two-body spin–orbit interaction between two-nucleon states, and also between states arising from configurations involving closed and almost closed shells. A.

539.152.1

6069. REALISTIC INDEPENDENT-PARTICLE MODEL OF THE NUCLEUS. A.E.S.Green.
Phys. Rev., Vol. 102, No. 5, 1325-34 (June 1, 1956).

A phenomenological central potential is explored which is characterized by a universal depth (V_0), a universal surface extension (d), and an inner radius function $a = a_1A^{1/3} + a_0$. The four parameters are adjusted to be in accord with experimental information obtained from low-energy neutron scattering and from neutron separation energies. The results $V_0 = 40$ MeV, $d = 1$, $a_1 = 1.32$, and $a_0 = -0.8$ (all in units of 10^{-13} cm), are in reasonable accord with what might be expected from other experimental and theoretical considerations. Since the experimental data used in the adjustment process bound the energy region in which the discreteness of nuclear energies is most evident, one might expect that the eigenvalues and eigenfunctions based upon this phenomenological model would furnish a highly realistic set for the theoretical study of low-energy nuclear transitions within the framework of the independent-particle model of the nucleus. The energy eigenvalues and the important parameters for the energy eigenfunctions are calculated by a procedure suitable for the restricted type of potential under consideration. A simple method is presented for handling small perturbations, particularly the Coulomb perturbation. In the latter case, it is shown that the derived proton eigenvalues agree with experimental proton separation energies, provided one introduces an anomalous attractive potential which cancels approximately one-half of the classical Coulomb potential acting upon an individual proton. The implications of these results are discussed. A.

539.152.1

6070. ENERGY LEVELS OF Np^{237} POPULATED BY ALPHA DECAY OF Am^{241}. J.M.Hollander, W.G.Smith and J.O.Rasmussen.
Phys. Rev., Vol. 102, No. 5, 1372-7 (June 1, 1956).

The conversion electron spectrum following alpha decay of Am^{241} has been reinvestigated with 180^0 focusing beta-ray spectrographs at ~ 0.1% resolution. Multipolarity assignments for several gamma transitions are made, principally on the basis of relative L-subshell conversion coefficients. Energy-level spacings and relative transition probabilities are compared and discussed in terms of the Bohr–Mottelson model. The excellent agreement of energy-level spacings with the rotational formula and the general pattern of radiative transitions firmly establish the essentially rotational nature of these bands of levels. However, calculations involving M1 transition probabilities and magnetic moments lead to discrepancies with the simple theory in the case of the ground rotational band.
A.

539.152.1

6071. NUCLEON ENERGY LEVELS IN A DIFFUSE POTENTIAL. A.A.Ross, H.Mark and R.D.Lawson.
Phys. Rev., Vol. 102, No. 6, 1613-20 (June 15, 1956).

The level sequence and shell structure for the bound single-particle states of nucleons moving in the spherically symmetric potential $V(r) = -V_0/[1 + \exp\alpha(r - a)]$ have been examined. For protons, a Coulomb potential was added corresponding to a uniform charge distribution out to the "nuclear radius", a, and the potential depth was increased to give sufficient binding energy for the last proton level in the nucleus under consideration. For $\alpha = 1.45 \times 10^{+13}$ cm^{-1} (implying a surface layer of approximately 3×10^{-13} cm, which is constant for all A), a spin-orbit coupling 39.5 times the Thomas term and $a = 1.3A^{1/2} \times 10^{-13}$ cm, good shell structure is obtained for both neutrons and protons. The level sequences obtained are in close agreement with experiment except in the region of strong distortion from sphericity. For $V_0 = 42.8$ MeV the neutron binding energies are in reasonable agreement with experiment. With these parameters the 3s and 4s giant resonances in the low-energy neutron scattering cross-section occur at A = 56 and 166 respectively. The neutron and proton

distributions in $_{79}Au^{197}$ are examined. With the values of α, r_0 and λ given above, the thickness of the surface layer on the proton distribution is 1.92×10^{-13} cm and the radius is 6.77×10^{-13} cm. A.

539.152.1

6072. DEVIATIONS FROM MAYER'S SCHEME FOR FILLING NUCLEAR SHELLS AND THE INTERACTION OF LEVELS. V.A.Filimonov.
Zh. éksper. teor. Fiz., Vol. 28, No. 6, 753-5 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 585 (Nov., 1955).

It is suggested that the deviations arise due to a strong interaction between similar nucleons in neighbouring orbital angular momentum quantum number levels having the same spin orientation with respect to the orbit. This interaction may be considered as the extraction of a nucleon from the filled level of lower l and the coupling of it to one of the odd nucleons of the higher levels. The postulate provides an explanation for the magnetic moments of Na^{23} and Mn^{55}. J.Hughes

539.152.1

6073. A STUDY OF THE ENERGY LEVELS OF THE LITHIUM NUCLEUS BY THE METHOD OF MAGNETIC ANALYSIS. L.M.Khromchenko and V.A.Blinov.
Zh. éksper. teor. Fiz., Vol. 28, No. 6, 741-3 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 596-600 (Nov., 1955).

A lithium target was bombarded with deuterons at three energies in the range 3.7 to 4.7 MeV, and the reaction products analysed with a magnetic analyser. Excited levels were found at 0.476, 4.454 and 6.530 MeV in Li^7 and 0.997 MeV in Li^6, in agreement with other workers. J.Hughes

539.152.1

6074. COMPARISON OF STABILITY OF NUCLEAR SHELLS AND SUB-SHELLS. V.A.Kravtsov.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 408-11 (1956). In Russian.

The magnitudes of the jumps in the curves of e_α, the energy of α-particle emission, are studied for light and medium nuclei. G.E.Brown

539.152.2

6075. ANGULAR MOMENTA AND PARITIES OF THE EXCITED STATES OF Cd^{114}. J.N.Brazos and R.M.Steffen.
Phys. Rev., Vol. 102, No. 3, 753-61 (May 1, 1956).

Angular correlation experiments have been performed on the 0.722 MeV–0.556 MeV gamma–gamma cascade of Cd^{114} in order to determine the angular momenta and the parities of the nuclear states involved. The directional correlation of the two gamma-rays is indicative of a pure quadrupole–pure quadrupole cascade between states of angular momentum quantum number 4, 2 and 0. The polarization-directional correlation experiments show that all three states involved have the same parity, and furthermore, give strong support to the angular momentum assignment mentioned above, Hence, the K-capture decay in In^{114} which precedes this gamma–gamma cascade must originate in the 50 day isomeric state of In^{114} with I = 5 and not in the 72 sec ground state with I = 1. Observations of the gamma-radiation directly following the 72 sec decay confirmed this result. Directional correlation measurements on ten In^{114} sources of very different chemical and physical structure did not reveal any evidence of extranuclear perturbation effects on the Cd^{114} gamma–gamma correlation. A.

539.152.2

6076. SPIN OF N^{16}. B.J.Toppel.
Phys. Rev., Vol. 103, No. 1, 141-2 (July 1, 1956).

Observations have been made on the intensity ratio of the 6.13 to 7.11 MeV gamma-rays of O^{16} following decay of N^{16} in order to test the possibility that the ground and first excited states of N^{16} have spin 0– and 3– as preliminary results of recent calculations by Elliott have predicted. The ratio was obtained with N^{16} made by the $O^{16}(n, p)N^{16}$ reaction and by the $F^{19}(n, \alpha)N^{16}$ reaction. For the first reaction, the ratio was obtained for two ages of the N^{16}. The constancy of the resulting intensity ratios implies that the theoretical prediction is not correct. A.

539.152.2

6077. NUCLEAR MAGNETIC RESONANCE. E.R.Andrew.
London: Cambridge University Press (1955) xi + 265 pp.

Review in Brit. J. appl. Phys., Vol. 7, No. 5, 194-5 (1956).

539.152.2

6078. A MODEL-INDEPENDENT DESCRIPTION OF THE MODULATION EFFECT IN NUCLEAR INDUCTION. K.Halbach..
Helv. phys. Acta, Vol. 29, No. 1, 37-46 (1956). In German.

A general theory of the change of magnetic polarization as a function of time as a consequence of the application of a modulation field. The results should be applicable to nuclear resonance, electron resonance, pure quadrupole resonance and to acoustic experiments. D.H.Whiffen

539.152.2

6079. DYNAMICAL THEORY OF NUCLEAR INDUCTION. II. F.Bloch.
Phys. Rev., Vol. 102, No. 1, 104-35 (April 1, 1956).

This paper represents the generalization of an earlier theory (Abstr. 2619/1953) by Wangsness and the author in which the phenomena of relaxation were treated by considering the interaction of individual nuclear moments with the molecular system and assuming that the latter remains always in thermal equilibrium. Instead of a single nuclear moment, the representative spin system is here allowed to consist of several moments, interacting with each other, and the corresponding general Boltzmann equation for the distribution matrix is developed. A first application is given by investigating the effect of a weak alternating field in the vicinity of resonance conditions. It is seen that the phenomenon of saturation is closely related to the change of populations in states, other than the two between which the resonance transitions occur. This general type of Overhauser effect is shown to be equivalent to that of a d.c. circuit, and it is illustrated by a special example. The general formalism is adapted to the treatment of a nuclear spin system in a strong constant field with particular attention to the structure of resonance spectra in liquids, due to chemical shift and spin coupling. A special case is that where the spin coupling causes a splitting of the lines, large compared to their natural width and their broadening due to the alternating field. An expression for the signal, obtained in this case, is developed and the effect of the spin coupling upon the effective longitudinal and transverse relaxation time is illustrated by the particular example of the two coupled nuclei of spin 1/2 and with independent dipole relaxation. New phenomena appear if the rate of relaxation-transitions is comparable or large compared to the frequency separation of resonance lines, due to spin coupling. The effect of such transitions by some nuclei upon the line width and structure of the resonance of others is investigated, assuming the spin coupling to be small compared to the chemical shift. Similar effects occur to the resonances of a nucleus in a weak alternating field, if other nuclei are at the same time irradiated by an alternating field of different frequency and sufficiently strong for its effect to be comparable or large compared to that of the spin coupling. It is shown that, even for the case of a single kind of nucleus, the presence of the strong field causes a doubling of the resonance with the weak field which can be used to calibrate the strength of the former by a frequency measurement. Another illustration is given in the case of two nuclei and explicit expressions for line width and intensity are given for the example of two nuclei with spin 1/2 and independent dipole relaxation. A.

539.152.2

080. PARAMAGNETIC RESONANCE ABSORPTION IN RANIUM (III) CHLORIDE AND THE NUCLEAR SPIN OF RANIUM-235. C.A.Hutchison, Jr, P.M.Llewellyn, E.Wong nd P.Dorain.
hys. Rev., Vol. 102, No. 1, 292 (April 1, 1956).
Resonance of U^{+++} in UCl_3 diluted with $LaCl_3$ indicates $_{\parallel}$ = 4.153 ± 0.005, $g_{\perp}$ = 1.520 ± 0.002 and for the U^{238} isotope = 7/2 and A = 0.0176 ± 0.0001 and B = 0.00568 ± 0.00003 cm^{-1}. ζ = 1300 cm^{-1} μ = 0.38 n.m. and if ζ = 1700 cm^{-1} μ = 0.31 n.m. he resonance closely resembles that of Nd^{+++} ($^4I_{9/2}$) with f^3 magnetic electrons and so a $5f^3$ structure is indicated for $^{+++}$. D.H.Whiffen

539.152.2

081. NUCLEAR MAGNETIC RESONANCE MEASUREMENTS OF THE ISOTOPES BARIUM-135 AND BARIUM-137. I.E.Walchli and T.J.Rowland.
hys. Rev., Vol. 102, No. 5, 1334 (June 1, 1956).
By comparison with the niclear magnetic resonance of Cl^{35}, the nuclear magnetic moments of Ba^{135} and Ba^{137} were ound to be 0.832 293 ± 0.000 025 and 0.931 074 ± 0.000 055, espectively, without diamagnetic correction. A.

539.152.2

082. ON THE EXCITATION OF "FREE PRECESSION" OF NUCLEAR MAGNETIC MOMENTS. G.Laukien.
Z. Naturforsch., Vol. 11a, No. 3, 222-37 (1956). In German.
A theoretical and experimental investigation of nuclear precession signals as a function of the length, intensity, frequency and number of inducing impulses. D.H.Whiffen

539.153

6083. THEORY OF THE LAMB–RETHERFORD EFFECT. E.Arnous.
Cahiers de Phys., No. 66, 1-5 (Feb., 1956). In French.
A review of existing theoretical treatments.
L.Pincherle

539.153

6084. EXPERIMENTAL STUDY OF THE LAMB–RETHERFORD EFFECT OF THE LEVEL n = 2 OF THE HYDROGEN ATOM. J.C.Pebay Peyroula.
Cahiers de Phys., No. 66, 6-16 (Feb., 1956). In French.
A review of experimental methods and results.
L.Pincherle

539.153

6085. d^np CONFIGURATIONS OF Ti II AND Ni II. N.Sack.
Phys. Rev., Vol. 102, No. 5, 1302-3 (June 1, 1956).
The term values of d^2p in Ti II and of d^8p in Ni II are calculated, taking into account the distortions due to interaction with higher configurations, by a method which is a generalization of the L(L + 1) correction. Mean deviations of the calculated values from the experimental ones of 140 cm^{-1} in Ti II and of 130 cm^{-1} in Ni II are obtained. A.

539.153

6086. THE DESTRUCTION OF METASTABLE HELIUM ATOMS BY COLLISION-INDUCED RADIATION. E.H.S.Burhop nd R.Marriott.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 271-9 (March, 1956).
A calculation has been made of the cross-section for destruction of $He(2^1S)$ metastable atoms by collision-induced radiation in two-body collisions with neutral helium atoms. The four-electron wave-functions used for the system were built up from unperturbed atomic orbitals. Assuming the form of interaction between normal and metastable atoms calculated by Buckingham and Dalgarno which exhibits a repulsive barrier of a height of 0.26 eV at separations greater than 2.1 x 10^{-8} cm, the calculated cross-section was 9 x 10^{-26} cm^2 at a temperature of 300°K. However, even if no barrier was assumed the cross-section increased only to 5 x 10^{-22} cm^2, still much too small to account for the value of 3 x 10^{-20} cm^2 measured by Phelps for the destruction cross-section. A.

539.153

6087. FINE STRUCTURE OF THE HYDROGEN ATOM. W.E.Lamb, Jr.
Science, Vol. 123, 439-42 (March 16, 1956).
The Nobel prize lecture reviews the applications of microwave methods in determinations of the energy separations of the 2S and 2P states. Theoretical calculations of level shifts are also considered. R.A.Newing

539.153.4

6088. CONCERNING APPROXIMATIONS TO THE THOMAS–FERMI FUNCTION. H.A.Buchdahl.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 238-41 (1956). In German.
A simple analytic function is proposed which has a better asymptotic behaviour than the approximation proposed by Tietz (Abstr. 3983/1955) and agrees well with the exact function over the entire range. The function has the form $y\ [(1 + ax)(1 + bx)(1 + cx)]$. Values for a, b and c are given. G.E.Brown

539.153.4

6089. DEFINITION OF SCHRÖDINGER'S H-OPERATOR FOR THE HYDROGEN ATOM. J.Colmez.
Ann. sci. Ecole Normale Supér., Vol. 72, No. 2, 111-49 (1955). In French.
The domain in which an operator A is usually defined in quantum mechanics is not sufficient to ensure that A is Hermitian. This fact is demonstrated for the operator $\Delta^2 + 1/r$. In the domain of continuous functions with continuous first and second derivatives (except at the origin), there exists, besides the usual wavefunctions, a non numerable infinity of solutions, a fact which is impossible for a Hermitian operator. L.Pincherle

539.153.4

6090. ON THE RIGOROUS SOLUTION OF SCHRÖDINGER'S EQUATION FOR ATOMS WITH TWO ELECTRONS. P.Pluvinage.
C.R. Acad. Sci. (Paris), Vol. 242, No. 17, 2109-11 (April 23, 1956). In French.
With the use of the variables $\rho = r_{12}/(r_1 + r_2)$; $\tau = (r_1 - r_2)/(r_1 + r_2)$; $x = 2(-E)^{1/2}(r_1 + r_2)$, the solution may be written as a sum of products of Laguerre polynomials in x, times certain two indices polynomials in ρ and τ. The method of calculation of the eigenvalues is then that described in Abstract 1493 (1956). L.Pincherle.

539.153.4

6091. UNRESTRICTED HARTREE–FOCK METHOD. G.W.Pratt, Jr.
Phys. Rev., Vol. 102, No. 5, 1303-7 (June 1, 1956).
The unrestricted Hartree–Fock method is based upon the use of a single-determinant total wave-function in which orbitals of the same n, l, and m_l values but different m_s values are regarded as being independent. The differences which arise between such orbitals are discussed. It is shown, using the Li atom as an example, that these differences are not merely a result of using a single determinant which has improper symmetry, but arise when the full spin-degeneracy problem is carried through. Conclusions for Li are generalized to more complicated systems. The influence of the unrestricted Hartree–Fock method on the calculation of magnetic form factors, its influence on hyperfine interactions, and its bearing on antiferromagnetism is pointed out. A.

539.153.4

6092. APPLICATION OF THE RAYLEIGH–SCHRÖDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM. R.E.Trees.
Phys. Rev., Vol. 102, No. 6, 1553-6 (June 15, 1956).
Wigner has calculated the ground-state energy of the hydrogen atom with second-order perturbation theory, the whole electrostatic potential being considered as the perturb-

ation. Though his result is finite, it does not agree with the known energy for hydrogen. A fact implicit in the literature, but not usually appreciated in this connection, is pointed out—that if part of the electrostatic energy is retained in the zero-order problem, a correct result is obtained, even if the part of the energy retained is given a zero magnitude after the calculation is carried out. It is also shown that if the calculation is carried out in an Einstein hypersphere, the entire "electrostatic potential" can be regarded as the perturbation and the correct result is obtained. Perturbation theory leads to the exact energy eigenvalue in all approximations higher than the first, but the expansion of the eigenfunction converges slowly if the perturbation is made large. A.

539.153.4

6093. LOWER BOUND TO THE GROUND-STATE ENERGY AND MASS POLARIZATION IN HELIUM-LIKE ATOMS. L.Wilets and I.J.Cherry.
Phys. Rev., Vol. 103, No. 1, 112-15 (July 1, 1956).

Using a method which involves finding the expectation value of the square of the Hamiltonian, lower bounds to the ground state energies of He, Li^+ and O^{6+} have been obtained from existing Hylleraas-type wave functions. The limit of error in the Chandrasekhar–Herzberg 18-parameter helium upper bound, −2.903 706 3 atomic units (a.u.), is found to be in absolute value less than 0.001 79 a.u. and "probably" less than 0.000 09 a.u. (~ 20 cm^{-1}). These results would seem to indicate that the Hylleraas series is not as rapidly convergent as previously thought. Again using existing Hylleraas-type wave functions, values have been obtained for the mass polarization (specific mass effect) in the same helium-like atoms. The value obtained for helium is somewhat different from that given by Bethe. A.

539.153.4

6094. FIRST APPEARANCE OF ATOMIC ELECTRONS WITH GIVEN l, n, n_r AND n + l. V.M.Klechkovskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 199-201 (1956). In Russian.

Further rules for the order of filling atomic levels are given. G.E.Brown

539.155.2

6095. PREPARATION OF 99.8% NITROGEN-15 BY CHEMICAL EXCHANGE. W.Spindel and T.I.Taylor.
J. chem. Phys., Vol. 24, No. 3, 626-7 (March, 1956).

This was achieved in a two-stage cascade utilizing the exchange reaction: $N^{15}O(g) + HN^{14}O_3(aq) \rightleftharpoons N^{14}O(g) + HN^{15}O_3(aq)$ (Abstract 7309/1955). The columns (520 cm and 550 cm long and 2.5 cm and 0.9 cm diameter respectively, constructed in Pyrex glass) were operated for an overall period of 25 days; steady-state operation at 99.8% N^{15} being achieved after 14 days. Material containing 6.0 g of nitrogen analysing at 99% N^{15} or higher was produced. Details of the design and operation of the plant are given. H.C.Cole

539.155.2 : 541.133.1

6096. ISOTOPIC ENRICHMENT OF BROMINE BY ELECTROLYTIC TRANSPORT IN MOLTEN LEAD BROMIDE. A.E.Cameron, W.Herr, W.Herzog and A.Lundén.
Z. Naturforsch., Vol. 11a, No. 3, 203-5 (1956). In German.

Enrichment (separation factor 1.28) of Br^{70} at a liquid lead anode took place in 7.8 days at a current density of 5.3 amperes per cm^3. The relative difference in migration velocity amounted to 0.11% corresponding to a mass effect, $\mu = -0.044 \pm 0.001$. The experimental methods, mass spectrometry and neutron activation, are described.. W.Good

539.155.4

6097. ON THE CLASSIFICATION OF NUCLIDES AND THEIR CHARACTERISTICS. G.Fournier.
Cahiers de Phys., No. 64, 1-10 (Dec., 1955). In French.

A graphical representation is given in terms of two quantities E(3Z − A) and I(A − 2Z). Attention is drawn particularly to the "stable" regions of these charts, and a mathematical relation between E and I deduced which represents most existing stable nuclei. A.O.Stanesby

539.155.4

6098. ATOMIC MASSES OF Ni^{58} AND Ni^{60}. P.C.Eastman, N.R.Isenor, G.R.Bainbridge and H.E.Duckworth.
Phys. Rev., Vol. 103, No. 1, 145-6 (July 1, 1956).

Mass spectrographic measurements are reported of the mass differences $C_2H_4O_2$—Ni^{60} and C_3H_6O—Ni^{58}. These results are used, together with existing data, to discuss certain discrepancies between transmutation and mass spectroscopically determined masses in the Fe-Ni-Zn section of the atomic mass table. A.

539.155.4

6099. A NEW DETERMINATION OF THE MASSES OF S^{32}, S^{33}, S^{34} AND C^{12}. G.v.Schierstedt, H.Ewald, H.Liebl and G.Sauermann.
Z.Naturforsch., Vol. 11a, No. 3, 216-21 (1956). In German.

The masses were determined from the doublets O_2-S^{32}, HS^{32}-S^{33}, H_2S^{32}-S^{34} and C_3-H_2S^{34}. The problems involved in obtaining very high resolution with a mass spectrometer are reviewed, and a brief description of the spectrometer is given. The results are compared with those of other workers. J.Hughes

539.155.4 : 539.172.13

MASS OF B^{13} FROM THE NUCLEAR REACTION $Li^7(Li^7, p)B^{13}$. See Abstr. 5382

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16 : 523.51

6100. RADIOACTIVITY OF IRON METEORITES BY THE PHOTOGRAPHIC METHOD. S.Deutsch, E.Picciotto and F.G.Houtermans.
Nature (London), Vol. 177, 885-6 (May 12, 1956).

Preliminary measurements have been made on Toluca (Hamburg) and Carbo but these are marred by polonium contamination. In Toluca it was shown that all the activity was not confined in the troilite phase. J.M.Hough

539.16.08

6101. ANGULAR CORRELATIONS. O.Hittmair.
Acta phys. Austriaca, Vol. 10, No. 1-2, 66-80 (1956). In German.

A survey combining the theoretical and experimental view points. A.O.Stanesby

539.16.08

6102. CALCULATION OF THE RESOLUTION CURVES FOR COINCIDENCE SYSTEMS USING SCINTILLATION COUNTERS. L. Dick, R. Foucher, N. Perrin and H.Vartapetian.
C. R. Acad. Sci. (Paris), Vol. 242, No. 15, 1880-3 (April 9, 1956). In French.

539.16.08 : 771.53

6103. SPECIFIC α-RADIOACTIVITY OF ILFORD PLATES FOR NUCLEAR RESEARCHES. II. SURFACE ACTIVITY. S.Deutsch.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1166-8 (May, 1956). In French.

For Pt I, see Abstr. 966 (1954). Counting and measurement of α-tracks in the surface of C2 emulsions, excluding tracks of >50μ length due to cosmic rays, show the surface contamination to be about 0.24 α/cm^2 day, of which 85% is due to Rn and its decay products in the ambient air. This contamination limits the detection of radiation from samples of very low radioactivity. S.T.Henderson

539.16.08 : 550.93

104. DETERMINATION OF THE AGE OF FOSSILS BY THE ETHOD OF NATURAL RADIOACTIVE CARBON (C^{14}). .Labeyrie.
nde élect., Vol. 35, 1084-93 (Nov., 1955). In French.

The theoretical basis of the method is discussed in some etail. A short abridgement of the theory of probability is iven. A table compares the main characteristics of the ethods used by 8 workers from Libby (1946) to Hayes (1955), uch as quantity of carbon required, counts/min (rising from .7 to 470), efficiency of detection (rising from 6% to 52%), asic noise, time required for measurement (reduced from 000 min with 8 g of carbon to 14 min with 67 g of carbon by ayes, or 146 min with 7 g of carbon by Audric, both using cintillation counters); these values refer to contemporary arbon and a standard error of 100 years, and the maximum ge to reach this standard error has been raised from 28 000 o 48 000 years. The second part of the article compares ritically the three methods used: solid carbon in a Geiger ounter (Libby), carbon-containing gas in a proportional ounter (de Vries, Fergusson) and introduction of C^{14} into a cintillation counter, either in the scintillator itself or in a olvent for it (Audric, Pringle, Hayes). Comprehensive prac- ical details of these methods are given. V.Quittner

539.163

105. RADIATIONS FROM ^{176}W. A.Bisi, S.Terrani and .Zappa.
uovo Cimento (Ser. 10), Vol. 3, No. 3, 661 (March, 1956).

Measurements of the γ-ray spectrum, using a single- rystal scintillation spectrometer, indicated a single ray at 6.5 ± 1.5 keV. Upper limits of 0.006, 0.010 and 0.014 are laced on the intensity, relative to the kX-radiation, of γ-rays n the regions of 0.27, 0.51 and 1.50 MeV respectively. J.J.Wilkins

539.163

106. NEW ISOTOPES: Er^{172} AND Tm^{172}. D.R.Nethaway, I.C.Michel and W.E.Nervik.
hys. Rev., Vol. 103, No. 1, 147-8 (July 1, 1956).

Two new isotopes, Er^{172} of half-life 49.8 ± 1 hr, and Tm^{172} f half-life 63.6 ± 0.3 hr, have been found. The mass assign- ent of Tm^{172} was proven by direct mass separation, and that f Er^{172} by genetic relationship. The Tm^{172} isotope was found o emit a 1.5 MeV β^--particle, γ-rays of 1.79, 1.44, 1.09, 0.40, .18 and 0.076 MeV, and a K X-ray of 0.049 MeV. The mass ssignments of Er^{168}, Er^{171} and Tm^{171} were verified. A.

539.163.2

107. A NOTE ON THE DECAY OF ^{185}W. S.K.Bhattacherjee nd S.Raman.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1131-2 (May, 1956).

β-γ-coincidence measurements confirm the decay scheme f Bisi et al. (Abstr. 4012/1955). The relative intensity of he inner β-group is about 15%. A.O.Stanesby

539.163.2

108. PROPERTIES OF Fm^{252}. A.M.Friedman, .E.Gindler, R.F.Barnes, R.Sjoblom and P.R.Fields.
Phys. Rev., Vol. 102, No. 2, 585-6 (April 15, 1956).

The fermium was formed by bombarding californium with lpha particles, and the chemical separation is outlined. The lpha-particle energy was found by pulse-height analysis to be .04 ± 0.02 MeV, and the half life 22.7 ± 0.7 hours. An upper imit of 3000 days was set for the spontaneous fission half ife. J.Hughes

539.163.2

109. PROPERTIES OF Bk^{245}. L.B.Magnusson, A.M.Fried- nan, D.Engelkemeir, P.R.Fields and F.Wagner, Jr.
Phys. Rev., Vol. 102, No. 4, 1097-103 (May 15, 1956).

The radiations of 5-day electron-capturing Bk^{245} were neasured with electron spectrometer, scintillation spectro- neter, and alpha pulse analyser. Conversion electrons from 250 keV and ~ 390 keV transitions were observed. The electromagnetic spectrum contains L and K X-rays and 250 and 280 keV gamma-rays. The relative contributions to the X-ray intensities from the primary capture processes and from excited state conversions were determined by counting coincidences between the electromagnetic radiations. Bk^{245} decays primarily by electron capture (L/K = 0.33) to a 250 keV level in Cm^{245} The K and L conversion coefficients of the 250 keV transition are 1.76 and 0.44, respectively, indicating that the transition is M1. About 6% branching decay goes to a level at 630 keV. The lifetimes of the excited states are less than 2×10^{-9} sec. The intensity of alpha-particle emission is 1.05×10^{-3} per disintegration (alpha half-life 13 yr). Three alpha groups were resolved: 5.89 MeV (26%), 6.17 MeV (41%) and 6.37 MeV (33%). A.

539.163.2

6110. DISINTEGRATION OF Ge^{68}. B.Crasemann, D.E.Rehfuss and H.T.Easterday.
Phys. Rev., Vol. 102, No. 5, 1344-6 (June 1, 1956).

Ge^{68} was prepared by the bombardment of zinc with 37 MeV alpha-particles and separated chemically. The half-life of Ge^{68} is 275 ± 20 days, as determined by comparison with a Co^{60} standard over 10 months. The positron spectrum was measured with a thick-lens magnetic spectrometer. Positron groups from Ga^{68} have maximum energies of 1.94 and 0.92 MeV and relative intensities of 1 and 0.04, respectively; no positrons from Ge^{68} were observed above 0.3 MeV. The scintillation spectrum shows annihilation radiation and a 1.02 MeV gamma-ray from Ga^{68}. Comparison of areas under these two peaks, corrected for crystal efficiency, indicates that there are 14.4 ± 1.7 positrons per 1 MeV quantum. Within the probable error, this result is compatible with the decay of Ge^{68} by electron capture alone. A.

539.163.2

6111. DECAY OF Ce^{144}. I.Pullman and P.Axel.
Phys. Rev., Vol. 102, No. 5, 1366-72 (June 1, 1956).

The decay scheme of 282-day Ce^{144} was investigated using a thin-lens beta-spectrometer, proportional counters, and scintillation counters. Intensity measurements and coincidence studies were used to obtain the decay scheme. Two beta-rays were found; the main branch is a 76%, 309 ± 5 keV beta-ray to the ground state while the 24 ± 5%, 175 keV beta-ray goes to a 134 keV level in Pr^{144}. From this level there are three parallel γ-ray branches: In 15.3% of the Ce disintegrations one observed a 134 keV gamma-ray, in 7.2% a cascade of 81 keV and 54 keV gamma-rays, and in 1.5% a cascade of 100 keV and 34 keV. For the conversion of the 134 keV gamma-ray, $\alpha_K = 0.71 \pm 0.20$ and K/L = 7.1 ± 0.5, while for the 81 keV gamma-ray, $\alpha_K = 1.2 \pm 0.3$ and K/L = 5.8 ± 0.7. There is insufficient intensity in the 54 keV gamma-ray to explain observed coincidences and a strong unobserved 42 keV gamma-ray is implied. A.

539.163.2

6112. K-CAPTURE BRANCH IN Tm^{170}. P.P.Day.
Phys. Rev., Vol. 102, No. 6, 1572-4 (June 15, 1956).

The electromagnetic spectrum resulting from the decay of Tm^{170} has been examined on a ten-inch bent-crystal spectrometer. One gamma-ray, seven K X-rays, and one L X-ray were observed. The presence of Er K X-ray was established and shown to be due to a 0.15% K capture branch in the decay of Tm^{170}. The energy of the first excited state of Yb^{170} was found to be 84.229 ± 0.041 keV. The reflectivity of the bent-topaz crystal used in the spectrometer was found to obey the function $(1/E)^{1.35 \pm 0.05}$. A.

539.163.2

6113. RADIATIONS OF Te^{127} AND Te^{127m}. J.D.Knight, J.P.Mize, J.W.Starner and J.W.Barnes.
Phys. Rev., Vol. 102, No. 6, 1592-7 (June 15, 1956).

The radiations of Te^{127} and Te^{127m} have been examined by

beta-ray and gamma-ray scintillation spectrometry. Te^{127} (9.35 ± 0.10 hr) decays predominantly (99%) by a beta transition of end-point energy 695 ± 10 keV to the ground state of I^{127}. The remaining 1.0 ± 0.2% of the decay is accompanied by gamma-rays of energies 58.5 ± 1, 145 ± 2, 203 ± 3, 215 ± 4, 360 ± 4 and 418 ± 2 keV. By means of gamma-gamma coincidence measurements, these gamma-rays have been fitted into a consistent decay scheme which involves levels in I^{127} at 58.5, 203 and 418 keV. Te^{127m} (105 ± 2 days), which decays predominantly by the well-known 89 keV isomeric transition, also has a 1.5 ± 0.5% beta branch which populates the 58.5 keV level in I^{127} and another beta branch of total intensity ~0.013% which is accompanied by a gamma-ray of energy 665 ± 5 keV. Plausible spin and parity assignments for the excited levels of I^{127} are discussed. A.

539.163.2

6114. THE DECAY OF THE UX-COMPLEX. Ong Ping Hok, J.T.Verschoor and P.Born.
Physica, Vol. 22, No. 5, 465-80 (May, 1956).

The radiations of the UX-complex and of pure UZ were reinvestigated by means of a double-focusing beta-ray spectrometer and a gamma-scintillation spectrometer. A rapid method was worked out to obtain relatively pure UX_2 samples. The gamma-rays were measured with a photographic method. Sixteen gamma-transitions were found in UZ and twelve in UX_2; five of these transitions seemed to occur in both decays. From these data and a β-e^- coincidence measurement in UX_1 a tentative level scheme of the UX-complex was set up. The UZ-level proved to be the ground state of Pa^{234}, 60 ± 15 keV below the UX_2 level. A.

539.163.2

6115. ON THE DECAY OF Al^{25}. T.Stribel.
Z. Naturforsch., Vol. 11a, No. 2, 166-7 (1956). In German.

The γ-spectrum was examined using a NaI scintillation spectrometer; no line was observed apart from annihilation radiation, and it can be said that certainly less than 1 in 200 of the β^+-disintegrations leads to the 0.98 MeV level of Mg^{25}. A.O.Stanesby

539.164

6116. SOURCE-STRAGGLING OF α-PARTICLES FROM A POLONIUM SOURCE. N.K.Saha and K.L.Kaila.
Indian J. Phys., Vol. 29, No. 9, 417-28 (Sept., 1956).

By using a Lindemann electrometer in conjunction with a high megohm resistor and a shallow ionization chamber, complete Bragg curves are obtained for a Po-source of α-particles freshly separated from some old radon tubes, and for a second source about 29 months old. The latter shows by comparison a very distorted Bragg curve with its tail portion spread about 1 cm air beyond the maximum. The spread is interpreted as the superposition effect of a large number of separate ideal Bragg curves arising due to the finite source depth accumulated through ageing. A theoretical formula is developed taking into account the straggling due to the source depth as well as the Gaussian law of range straggling. The calculated results show good agreement with the observed Bragg curve. A.

539.164 : 539.172.13

6117. ALPHA SPECTRUM IN THE $Li^7(p,\gamma)Be^{8*}(\alpha)He^4$ REACTION. E.C.LaVier, S.S.Hanna and R.W.Gelinas.
Phys. Rev., Vol. 103, No. 1, 143-5 (July 1, 1956).

The alpha-particle spectrum in the $Li^7(p,\gamma)Be^{8*}(\alpha)He^4$ reaction was observed with magnetic analysis from 1.0-5.5 MeV, corresponding to excitation energies in Be^8 from 2-11 MeV. In addition to the well-known structure at E_{ex} = 2.9 MeV, very broad structure in the region of E_{ex} = 10 MeV was observed. No evidence was obtained for the existence of levels between 3 and 10 MeV. A

539.164

6118. VERY LONG LIVED NATURAL α-EMITTERS. W.Porschen and W.Riezler.
Z.Naturforsch., Vol. 11a, No. 2, 143-51 (1956). In German.

The elements La, Ce, Pr, Nd, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Cp, Hf, W, Re, Os, Ir, Pt, Au, Tl, Pb and Bi were investigated for weak α-activity with nuclear emulsions. Positive effects were found for Nd, W, Pt and Bi. J.Hughes

539.164.2

6119. THE THEORY OF α-DECAY OF NON-SPHERICAL NUCLEI. V.M.Strutinskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 411-12 (1956). In Russian.

In the case of even-even nuclei it is possible to develop the theory describing excitation of rotational levels in α-deca without making the adiabatic approximation (in which the rotation of the nucleus is taken as slow compared with that of the α-particle). G.E.Brown

539.164.75 : 537.534.75

ON THE IONIZATION—ENERGY RELATION FOR ALPHA PARTICLES IN AIR. See Abstr. 5161

539.165

6120. BETA SPECTRUM OF Cl^{36}. R.G Johnson, O.E.Johnson and L.M.Langer.
Phys. Rev., Vol. 102, No. 4, 1142-8 (May 15, 1956).

The twice forbidden beta spectrum of Cl^{36} has been measured with a 4π scintillation spectrometer which is particularly well suited for measuring beta spectrum shapes from sources with low specific activity. The distribution was measured to as low as 89 keV with three sources of average thicknesses of 9, 19, and 20 $\mu g/cm^2$. The data were analysed by using the exact twice forbidden shape factor for the linear combination of the S and T couplings for $\Delta J = 2$. The ratios of nuclear bet moments appearing in the shape factor were treated as variable parameters. The best fit to the data was for $R_{ij}/T_{ij} = 0$ and $A_{ij}/T_{ij} = 14.2$. A

539.16

6121. THE CONTINUOUS β-SPECTRUM OF RaC. H. Daniel and R.Nierhaus.
Z. Naturforsch., Vol. 11a, No. 3, 212-15 (1956). In German.

Examination with a two-lens magnetic spectrometer has shown that the spectrum is the superposition of the following: (3.26 ± 0.03) MeV (19%); (1.88 ± 0.08) MeV (9%); (1.51 ± 0.05) MeV (40%); (1.02 ± 0.12) MeV (23%); (0.42 ± 0.15) MeV (9%). L.Pincherl

539.165.08

6122. INTENSITY MEASUREMENTS IN 180° β-SPECTROGRAPHS BY MEANS OF COUNTING ELECTRON TRACKS IN NUCLEAR EMULSIONS. P.Kleinheins.
Z. Naturforsch., Vol. 11a, No. 3, 252-3 (1956). In German.

The advantages of using nuclear emulsions for detecting electrons in β-spectrographs are discussed. In particular the method provides an accurate measure of relative and absolute intensities. It also provides good discrimination against back ground tracks which can be rejected on account of angle or range. Some results are presented on the analysis of the spectrums of Cs^{137}, Co^{60} and Te^{127}. D.J.Prowse

539.165.2

6123. A TEST OF NEUTRINO—ANTINEUTRINO IDENTITY. C.L.Cowan, Jr, F.B.Harrison, L.M.Langer and F.Reines.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 649-51 (March, 1956)

Double β-decay was sought in gram quantities of the separated isotope Nd^{150}; none was found. It is concluded that the Majorana—Furry hypothesis of the identity of neutrino and antineutrino is inapplicable. A.O.Stanesby

539.165.2

6124. COUPLING CONSTANTS IN THE THEORY OF β DECAY. M.A.Preston and K.Kumar.
Phys. Rev., Vol. 102, No. 5, 1347-8 (June 1, 1956).

Certain symmetry arguments are used to suggest that the beta-decay interaction is S – T + P. It is shown that if the negative electron in these arguments is replaced by the positron, the result is S + T + P and that the proposed symmetries do not lead to Hermitian Hamiltonians which treat negatrons and positrons on the same footing. A.

539.165.2

6125. THE MESONIC CORRECTION IN β-DISINTEGRATION. B.Stech.
Z. Phys., Vol. 145, No. 3, 319-23 (1956). In German.

It is shown how simple relations for the mesonic corrections may be obtained without a perturbation calculation. They are connected to the sum of the magnetic moments of proton and neutron. The value obtained for the ratio of the Fermi coupling constant to the μ-meson disintegration constant is not in agreement with experiment. L.Pincherle

539.166

6126. NEUTRON-CAPTURE γ RAYS FROM VARIOUS ELEMENTS. T.H.Braid.
Phys. Rev., Vol. 102, No. 4, 1109-23 (May 15, 1956).

Neutron-capture γ-ray spectra have been measured in the energy range 0.3 to 3 MeV by means of a two-crystal Compton scintillation spectrometer. The efficiency of the instrument as a function of energy was determined experimentally. The uniqueness of the 2.23 MeV γ-ray following capture of a neutron by hydrogen has been confirmed, and this γ-ray was used as a standard to establish the absolute intensity of γ-rays from other elements. Most of the γ-rays observed can be understood in terms of known levels, and many appear to be emitted in transitions from such levels to the ground state. In many cases, the information obtained complements high-energy data in establishing preferred modes of decay of the product nucleus. In sodium a very strong γ-ray is emitted from the first excited state of Na^{24} at 0.47 MeV, and another ground-state γ-ray appears to be emitted from the level at 1.34 MeV. The strongest γ-ray in the magnesium spectrum is an E1 transition between the levels at 3.41 and 0.58 MeV in Mg^{25}. The aluminium spectrum is very complex, and only a few peaks have been resolved. A ground-state transition is seen from the level at 2.27 MeV in Al^{28}. In silicon two E1 transitions are observed from the capturing level to the levels at 4.93 and 6.38 MeV, and a ground-state transition is seen from the first excited state at 1.28 MeV. Ground-state transitions are observed from the levels at 0.52, 1.15, and 2.18 MeV in P^{32}. In sulphur, there is a strong ground-state γ-ray from the first excited state at 0.84 MeV, and a strong E1 transition to this level from that at 2.34 MeV. In chlorine almost all of the observed γ-rays can be understood as ground-state transitions from known levels in Cl^{36} at 0.79, 1.16, 1.95, 2.47 and 2.87 MeV. In K^{40} the decay scheme involves several level to level transitions. γ-rays to the ground state are observed from the levels at 2.05 and 3.40 MeV in K^{40}, and possibly from the 1.18 MeV level in K^{42}. The spectra from calcium and titanium are very simple. A strong γ-ray occurs almost once per capture in Ca^{40} from the 1.95 MeV first excited state of Ca^{41}, and a strong γ-ray from the 1.39 MeV first excited state of Ti^{49} occurs almost once per capture in Ti^{48}. In V^{52} most of the observed γ-rays are emitted by levels below 1 MeV. Ground-state transitions occur from the levels at 0.42 and 0.83 MeV. In Cr^{54} a very strong γ-ray to the ground state is emitted by the level at 0.84 MeV, and a weak transition may be from the 0.54 MeV level in Cr^{53} to the ground state. γ-rays to the ground state are observed from levels at 0.42 and 0.88 MeV in Ni^{59}. No definite identification can be made of the four γ-rays observed from zinc. The Cd^{114} spectrum contains many unresolved radiations; by far the most intense is the 0.56 MeV γ-ray which is emitted from the first excited state. A.

539.166

6127. GAMMA RAYS FROM THE PROTON BOMBARDMENT OF SEPARATED COPPER ISOTOPES. C.E.Weller and J.C.Grosskreutz.
Phys. Rev., Vol. 102, No. 4, 1149-56 (May 15, 1956).

The energy spectrum of γ-rays obtained from the proton bombardment of separated copper isotopes has been measured. It was found by coincidence measurements that the majority of these γ-rays arise from the capture process when the bombarding energy is held below 2.2 MeV. The thick target cross-section for proton capture at 1.9 MeV is found to be 0.1 millibarn. Above 2.2 MeV, excitation of the 0.67 MeV level in Cu^{63} by either inelastic scattering or Coulomb excitation is observed. Excited level schemes for both Zn^{64} and Zn^{66} have been obtained. The first three levels in Zn^{64} are found to be at 0.97, 2.27, and 3.04 MeV. The scheme for Zn^{66} is essentially the same as that earlier proposed from the decay of Ga^{66}. A.

539.166

6128. A NEW MEASUREMENT OF THE γ-RAY TRANSITION IN COINCIDENCE WITH THE β-DECAY OF S^{37}. T.Stribel.
Z. Naturforsch., Vol. 11a, No. 3, 254 (1956). In German.

The γ-ray emitted in coincidence with the β-decay of S^{37} has been measured with a scintillation spectrometer. The S^{37} was obtained through a (n, p) reaction on Cl^{37} using the fast neutrons from the Li(d, n) reaction. The value obtained is 3.09 ± .03 MeV which compares with the previous best value of between 2.7 and 2.75. The energy of the β-ray is being measured again. It is of importance because the mass defect of S^{37} is obtained via this energy and the known mass of Cl^{37}. D.J.Prowse

539.166

6129. DIRECTIONAL CORRELATION OF THE GAMMA RAYS OF La^{140}, Ce^{140}, Pt^{192}, AND As^{75}. W.H.Kelly and M.L.Wiedenbeck.
Phys. Rev., Vol. 102, No. 4, 1130-40 (May 15, 1956).

The decay scheme of La^{140} was investigated by using summing techniques. This scheme was found to be compatible with a modification of the scheme proposed earlier by other investigators. The 537 keV gamma-ray was found to parallel the other transitions. Directional correlation measurements made in the 162 keV to 304 keV cascade do not allow definite spin and multipole order assignment. The following spin sequence (in the order of decreasing energy) appears to be the most probable 1 (Q) 3 (D, Q) 4. Ce^{140} was found to have energy levels with spins 0, 2, 4 and 3 in the order of increasing energy. The multipole orders were found to be: 1.600 MeV quadrupole; 0.490 MeV quadrupole; 0.328 MeV dipole with some quadrupole admixture; and 0.815 MeV dipole with some quadrupole admixture. These assignments are in agreement with those made by other investigators. It was found that the energy levels of Pt^{192} have spins 0, 2, 2, 4 (3 cannot be definitely excluded) in the order of increasing energy. The spins of the fourth and fifth excited states could not be assigned unambiguously but were found to lie in the ranges 2 to 5 and 3 to 5, respectively. Multipole orders of the transitions were assigned as follows: 316 keV quadrupole; 468 keV quadrupole (some dipole admixture cannot be definitely excluded); 612 keV quadrupole; and 296 keV dipole-quadrupole mixture. These assignments are in rough agreement with those deduced from internal conversion measurements made by other investigators and with previous directional correlation results obtained by other investigators. The results obtained for As^{75} did not allow definite spin and multipole order assignments. However, the measurements permit limits to be placed on the spin assignments. The 281 keV level has spin 3/2 or 5/2 with 3/2 being preferred. The 269 keV level probably has spin 1/2 or 3.2 and the 405 keV state has a spin in the range 1/2 to 5/2 with 3/2 being preferred. A.

539.166

6130. GAMMA–GAMMA ANGULAR CORRELATION IN THE DECAY OF ^{48}Sc. B. van Nooijen, P. Mostert, J.F. van der Brugge and P.M.Endt.
Physica, Vol. 22, No. 3, 194-6 (March, 1956).

The angular correlation between the first and second gamma rays (1.04 and 1.32 MeV) in the triple cascade following the decay of Sc^{48} was measured. It is the same as that for the second and third members of the cascade and confirms the spin sequence 6, 4, 2, 0. M.A.Grace

539.166 : 539.172.11

6131. ANGULAR DISTRIBUTION OF γ-RADIATION FROM $^{9}Be(\alpha, n\gamma)^{12}C$. N.W.Tanner.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1195-7 (Dec., 1955).

Angular distributions have been measured at 6 α-particle energies between 1.2 and 2.5 MeV, particularly around the 1.905 ± 0.010 MeV resonance. The distributions are markedly anisotropic and varied. It is concluded that states at ~ 12 MeV excitation in C^{13} are not well defined, and no attempt is made to assign spins and parities. J.J.Wilkins

539.166 : 539.172.11

6132. ABOUT THE MEASUREMENT OF AN n–γ ANGULAR CORRELATION IN THE REACTION $Be^{9}(\alpha, n\gamma)C^{12}$. K.G.Steffen, O.Hinrichs and H.Neuert.
Z. Phys., Vol. 145, No. 2, 156-60 (1956). In German.

Using scintillation counter coincidence methods, the measured anisotropy was 0.00 ± 0.065 for the neutron group leading to the 4.43 MeV level in C^{12}. J.Hughes

539.166.83

6133. THE 0+ → 0+ TRANSITION IN Zr^{90}. T.Yuasa, J.Laberrigue-Frolow and L.Feuvrais.
C.R. Acad. Sci. (Paris), Vol. 242, No. 17, 2129-32 (April 23, 1956). In French.

Two internal conversion electron lines from a de-excitation of 1.74 MeV [$e_C/\beta^- = (1.6 \pm 0.6) \times 10^{-4}$] were found in a study of the internal conversion- and γ-spectra of Y^{90}; the corresponding γ-ray intensity $\gamma/\beta^- < 4.3 \times 10^{-6}$. This supports the existence of the 1.74 MeV 0+ → 0+ transition in Zr^{90} (See also Johnson et al., Abstr. 9000/1955). A.O.Stanesby

539.166.83

6134. INTERNAL CONVERSION SPECTRUM OF Au^{198}. D.R.Connors, W.C.Miller and B.Waldman.
Phys. Rev., Vol. 102, No. 6, 1584-6 (June 15, 1956).

An absolute energy determination for the internal conversion electrons from Au^{198} has been made with an electrostatic analyser. The gamma-ray energy has been determined from these results to be 411.76 ± 0.19 keV. The intensity ratios ($L_I : L_{II} : L_{III}$) in the L subshell are found to be (1.9 ± 0.3) : (2.2 ± 0.3) : 1.0, in agreement with theory for an E2 transition. A determination of the internal conversion coefficients gave $\alpha_K = 0.025 \pm 0.005$ and $\alpha_L = 0.012 \pm 0.002$. A.

539.166.83

6135. AUGER EFFECT IN HEAVY ATOMS. V.N.Mokhov and M.G.Urin.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 209-10 (1956). In Russian.

Formulae for the total number of Auger transitions per unit time are given and evaluated for Z = 47. Results agree well with experiment. G.E.Brown

539.166.831

6136. THE CONVERSION LENGTH OF HIGH ENERGY PHOTONS. K.Pinkau.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1156-8 (May, 1956).

The conversion length of photons in the energy range $>10^4$ MeV is found to be in agreement with the Bethe–Heitler theory, although previous experiments (Abstr. 451/1956) raised some doubts about its validity in this region. G.E.Brown

539.166.832

6137. TOTAL ELECTRON COMPTON CROSS SECTION AT 319 MeV. J.D.Anderson, R.W.Kenney and C.A.McDonald, Jr.
Phys. Rev., Vol. 102, No. 6, 1626-31 (June 15, 1956).

The total cross-section for Compton scattering of 319 MeV photons by electrons was measured in an indirect manner to be 2.8 ± 0.4 mb per electron. This result is 8% smaller than the theoretical cross-section given by the Klein–Nishina formula, but agrees within the experimental error. The data also yield the triplet-production cross-section for beryllium, which was found to be 36.0 ± 3.5 mb per beryllium atom. The theoretical value is 30.2 mb per beryllium atom. The total-absorption cross-sections for 319 MeV photons in beryllium and lead were found to be 161.3 ± 1.0 mb per beryllium atom and (37.620 ± 0.225) x 10^{-24} cm^2 per lead atom. The ratio of the pair-forming cross-sections in beryllium to those in lead, for 319 MeV photons, was found to be (3.986 ± 0.020) x 10^{-3}. The deviation from experiment of the Bethe–Heitler theory for pair production can be expressed by $\phi_p^Z = \phi_p^Z(B.H.) \times [1 - aZ^2]$, and a value a = (1.50 ± 0.08) x 10^{-5} is derived from the measured absorption cross-section for lead. Tables of the principal photon interaction cross-sections in beryllium at 319 MeV are included. A.

539.166.835

6138. FREE-RADICAL QUENCHING OF POSITRON LIFE-TIMES. S.Berko and A.J.Zuchelli.
Phys. Rev., Vol. 102, No. 3, 724-8 (May 1, 1956).

The annihilation lifetime of positrons stopping in benzene has been measured as a function of the percentage of added free radical, diphenylpicrylhydrazyl. The long component of the complex annihilation curve quenches from 2.67 x 10^{-9} sec in pure benzene to 5.3 x 10^{-10} sec at a 3% free radical concentration. An annihilation model following Bell and Graham's assumptions is discussed, postulating the partial formation of bound positron states prior to annihilation. The long lifetime is regarded then as a measure of the conversion rate from triplet to singlet states due to collisions of the positron system with the unpaired electrons of the free radical. The experimental points yield, using such a model, a conversion cross-section of $\sigma = 1.18 \times 10^{-17}$ cm^2. A.

539.166.835

6139. SPIN AND POLARIZATION EFFECTS IN THE ANNIHILATION OF TRIPLET POSITRONIUM. R.M.Drisko.
Phys. Rev., Vol. 102, No. 6, 1542-4 (June 15, 1956).

The annihilation rate of triplet positronium has been calculated without summing at once over spin and polarization. The results, quoted without proof, apply to some recent measurements of spin and polarization effects. A.

539.166.835

6140. NARROW COMPONENTS IN THE ANGULAR CORRELATION OF ANNIHILATION QUANTA FROM CONDENSED MATERIALS. L.A.Page and M.Heinberg.
Phys. Rev., Vol. 102, No. 6, 1545-53 (June 15, 1956).

Measurements on the angular correlation of two-photon annihilation of positrons within 10 milliradians of 180° show that amorphous materials, known or expected to have a long-lived component, have a more pointed distribution than crystal line materials, as though a narrow component were present. The former group includes fused quartz, Teflon, polystyrene, polyethylene, paraffin, Lucite and glass; the latter, crystalline quartz, aluminium, magnesium, copper, graphite and sulphur crystals. Cane sugar, either as "crystals" or as a plastic material, is empirically classified with the narrow-component group. Magnetic experiments up to 16.3 kilogauss cause a transfer of 3 to 4% of the annihilation events into the narrow component from the rest of the events, when the narrow component already exists in the material in agreement with the assumption that a triplet state of a positron–electron system is being quenched. Experiments under way are designed to

timate the positron–electron overlap by measurement of the eld dependence of this effect. A preliminary experiment on ssible diffusion of annihilation centres is described. A.

539.166.835

141. PAIR PRODUCTION IN THE FIELD OF ORBITAL LECTRONS BY A TOTAL-ABSORPTION METHOD AT 9 MeV. J.D.Anderson, R.W.Kenney, C.A.McDonald, Jr and F.Post.
ys. Rev., Vol. 102, No. 6, 1632-6 (June 15, 1956).

The attenuation of (319 ± 4) MeV photons in liquid hydrorbons has been measured and has been used to infer the oss-section for pair production in the field of the orbital ectrons (triplet production). Targets of benzene (C_6H_6) and clohexane (C_6H_{12}) were used in good geometry. A pair specometer with three fast counter channels was used to measure e intensity of the transmitted photon beam. The synchrotron as monitored with a modified pair spectrometer that was nsitive only to the bremsstrahlung spectrum above 300 MeV. ne total absorption cross-sections in hydrogen and carbon at .9 MeV have been found to be 18.0 ± 1.8 mb per hydrogen om, and 321.1 ± 2.8 mb per carbon atom, respectively. Subaction of the theoretical nuclear pair and electron Compton oss-sections and the experimental photomeson cross-sections hydrogen from the total hydrogen absorption cross-section ves 6.8 ± 1.8 mb for the experimental triplet cross-section, s compared with the theoretical value of 7.68 mb. Similarly, hen one subtracts the cross-sections for competing processes carbon, one gets for the triplet cross-section at 319 MeV e value 46.6 ± 6.4 mb, compared with the theoretical value of 4.4 mb. The large uncertainty in the carbon triplet crossection is due to uncertainties in the cross-sections for the ompeting processes. A.

539.166.84

142. ON THE INTERNAL AND EXTERNAL BREMSSTRAHLUNG, AND THE AUTOIONIZATION IN THE K SHELL OF Pr^{143}. H.Langevin-Joliot.
C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 1971-4 (April 16, 956). In French.

See Abstr. 2381 (1956). Further measurements confirm hat the observed and theoretical internal bremsstrahlung spectra differ in intensity and form. The observed intensity s 1.6 times theoretical at 20 keV, and 2.4 times theoretical bove 80 keV. External spectra from C and Al targets are iven. The probability of K-autoionization is found to be 4.2 ± 0.8) x 10^{-4} per disintegration. J.J.Wilkins

NUCLEAR REACTIONS 539.17

539.172

143. ANOMALY IN ENERGY LEVEL DENSITY MEASUREMENTS. G.Igo and H.E.Wegner.
Phys. Rev., Vol. 102, No. 5, 1364-5 (June 1, 1956).

An analysis of nuclear reactions in the intermediate energy range has been made in terms of the statistical theory of uclear reactions using the Fermi gas level density, const x exp$[(aE)^{1/2}]$, where E is the energy of excitation. The quantity, a, determined from excitation function experiments nd from the (α, p) reaction at 40 MeV shows an anomalous behaviour when plotted against atomic number, A. On the other hand, the values of a determined from several inelastic scattering and reaction experiments show the correct dependence on A. The effects of noncompound-nucleus processes are discussed. A.

539.172

144. ELASTIC SCATTERING OF NITROGEN BY NITROGEN. H.L.Reynolds and A.Zucker.
Phys. Rev., Vol. 102, No. 5, 1378-84 (June 1, 1956).

The differential cross-section for the elastic scattering of nitrogen from nitrogen was measured for incident nitrogen laboratory energies of 15.0, 17.7, 19.2 and 21.7 MeV and laboratory angles from 15° to 55°. The scattering occurred in nitrogen gas and the particles were detected with a nuclear emulsion placed in a one-slit camera. At 15 MeV, the scattering is entirely due to the Coulomb potential. The interference term in the Mott scattering cross-section of two identical particles can be seen as a rise in the cross-section near 45°, illustrating the fact that nitrogen is a Bose–Einstein particle. The angular resolution is not sufficient to enable the precise measurement of the spin. At the higher energies the cross-section drops below the Mott cross-section at angles greater than 30°, due to the nuclear absorption of the particles as the apsidal distance approaches the sum of the two nuclear radii. At an energy of 21.7 MeV and an angle of 45°, the cross-section is $\frac{1}{8}$ of the Mott cross-section. A calculation which uses the strong absorption model of Blair, fits the differential cross-section at 21.7 MeV quite well. In order to fit the data, the contributions from values of l up to 6 must be subtracted from the Coulomb cross-section; this indicates that the nuclear radius of nitrogen is 4.0 x 10^{-13} cm. From this calculation the total nuclear absorption cross-section for 21.7 MeV nitrogen on nitrogen is inferred to be 3.4 x 10^{-25} cm^2. A.

539.172

6145. ANTIPROTON INTERACTION CROSS SECTIONS. O.Chamberlain, D.V.Keller, E.Segrè, H.M.Steiner, C.Wiegand and T.Ypsilantis.
Phys. Rev., Vol. 102, No. 6, 1637-40 (June 15, 1956).

Using the 1.19 BeV/c antiproton beam recently discovered at the Berkeley Bevatron of the University of California, the attenuation cross-section in beryllium and copper was measured. These cross-sections are compared to attenuation measurements made with the same geometry using positive protons of the same incident energy (497 MeV). The measurements were made at cutoff angles θ_C of 12.7° for copper, and at 18° for beryllium. For both copper and beryllium the measured attenuation cross-section for antiprotons is twice that for positive protons, with a statistical error of ± 15%. In addition, for both elements, more than half the attenuation events resulted in one or more fast charged secondary particles ($\beta \geq 0.75$) — probably indicating that annihilations had taken place. The cross-section results are: for copper at $\theta_C = 12.7°$, $\sigma_p^- = 1.58 \pm 0.22$, $\sigma_p^+ = 0.780 \pm 0.069$; and for beryllium at $\theta_C = 18°$, $\sigma_p^- = 0.365 \pm 0.059$, $\sigma_p^+ = 0.178 \pm 0.013$, where the units are 10^{-24} cm^2. For copper and beryllium, respectively, the average energies in the absorbers were 430 and 455 MeV. A.

539.172 : 530.162

APPLICATION OF THE THEORY OF STOCHASTIC PROCESSES TO INVESTIGATION OF NUCLEAR FISSION. See Abstr. 4854

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172

6146. CALCULATION OF ELECTRON–DEUTERON SCATTERING CROSS SECTIONS. V.Z.Jankus.
Phys. Rev., Vol. 102, No. 6, 1586-91 (June 15, 1956).

Elastic and inelastic cross-sections for electron-deuteron scattering with large momentum transfer have been investigated. The calculation has been performed in the first Born approximation. The neutron–proton interaction has been described by a phenomenological potential, and the nucleons have been represented by point charges and point magnetic moments. Finite size of nucleons causes major correction to these results. A.

539.172

6147. SINGLE SCATTERING OF FAST ELECTRONS BY ATOMIC NUCLEI. K.K.Damodaran and R.M.Curr.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 196-204 (March, 1956).

An attempt has been made to check the validity of Mott's theory of single scattering of electrons by heavy nuclei such as silver, platinum and uranium at various angles of scattering and thus to investigate whether there is any marked deviation from theory at large angles of scattering as observed by some previous workers. An electron beam from the 4.5 MeV microtron was used for the experiment and the scattered electrons were detected in Ilford G5-50 micron emulsions. It has been found from these measurements that the scattering of 4.33 MeV electrons by the above nuclei agrees with Mott's theory within the experimental accuracy of a few % for angles of scattering from 45° to 90°. Measurements made at angles of scattering of 120° and 135° were found to have been affected by the presence of spurious scattering from the walls of the apparatus so that no definite conclusions can be drawn regarding the scattering at these angles. A.

539.172

6148. NUCLEAR SCATTERING OF HIGH ENERGY ELECTRONS ON THE INDEPENDENT-PARTICLE MODEL. L.J.Tassie.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 205–13 (March, 1956).

A simple independent-particle model is used to treat the elastic and inelastic scattering of electrons by light nuclei at high energies, using the relativistic first Born approximation. The matrix elements are calculated for a harmonic oscillator nucleus and a spherical box nucleus. Comparison is made with experiment for the scattering of 190 MeV electrons by Be^9 A.

539.172.11

6149. NEUTRONS AND GAMMA RAYS FROM THE ALPHA-PARTICLE BOMBARDMENT OF Be^9, B^{10}, B^{11}, C^{13}, AND O^{18}. T.W.Bonner, A.A.Kraus, Jr, J.B.Marion and J.P.Schiffer.
Phys. Rev., Vol. 102, No. 5, 1348-54 (June 1, 1956).

Excitation curves at 0° and 90° were studied for neutrons and γ-rays produced in thin targets by α-particles with energies of from 1.8 to 5.3 MeV. Resonances were observed in the $Be^9(\alpha, n)\ C^{12}$ reaction at bombarding energies of 1.9, 2.3, 2.6, 3.98, 4.4 and 5.0 MeV. The $C^{13}(\alpha, n)O^{16}$ reaction showed resonances at 2.09, 2.25, 2.42, 2.605, 2.69, 2.775, 2.825, 3.09, 3.33, 3.42, 3.67, 3.73, 4.125, 4.42, 4.50, 4.63, 4.75 and 5.05 MeV. The $B^{10}(\alpha, n)N^{13}$ excitation curve has resonances at 2.16, 2.25, 2.90, 4.53, 4.85 and 5.36 MeV, while the γ-ray yield from the $B^{10}(\alpha, p\gamma)C^{13}$ reaction showed all these as well as resonances at 3.6 and 3.95 MeV. The $B^{11}(\alpha, n)C^{13}$ reaction has resonances at bombarding energies of 2.06, 2.60, 2.93, 2.97, 3.23, 3.54, 3.72, 3.92, 4.25, 4.34 and 5.00 MeV. The $O^{18}(\alpha, n)Ne^{21}$ reaction was studied with a thicker target (90-130 keV). Resonances in the neutron yield were resolved at 2.21, 2.47, 2.57, 2.72, 2.94, 3.24, 3.63, 3.91, 4.12, 4.22, 4.33, 4.52 and 4.82 MeV. Cross-sections and widths of the resonances in the various reactions were determined. A.

539.172.13

6150. SCATTERING OF 40-MeV PROTONS FROM He^4. R.M.Eisberg.
Phys. Rev., Vol. 102, No. 4, 1104-8 (May 15, 1956).

The existence of an excited state in He^4 may be investigated by bombarding these nuclei with a mono-energetic beam of protons and looking for a group of inelastically scattered protons corresponding to excitation of the state. Using this technique at a bombarding energy of 32 MeV, Benveniste and Cork found no evidence of a state in He^4 of excitation energy less than 23 MeV. The 40 MeV beam of the Minnesota proton linear accelerator has been used to extend the search for a state in He^4 to higher excitation energies. A gas target was bombarded and particles emitted at forward angles were detected in a scintillation counter which measured their energy. By observing the energy less in traversing thin foils, the masses of the emitted particles were determined. Elastically scattered protons and recoil He^3 were seen, as well as deuterons and recoil He^3 from the ground state (p, d) reaction. A continuum of protons from (p, 2p) and (p, pn) reactions was observed. No evidence was found for a group of inelastically scattered protons corresponding to exctiation of a state in He^4 of energy less than 28 MeV. A

539.172.1

6151. OPTICAL-MODEL POTENTIAL FOR NUCLEONS SCATTERED BY NUCLEI. W.B.Riesenfeld and K.M.Watson.
Phys. Rev., Vol. 102, No. 4, 1157-63 (May 15, 1956).

The Serber model of high-energy nuclear interactions permits one to express the "optical-model" potential for nucleons in terms of nucleon–nucleon scattering amplitudes. The potential is written in terms of four well-depth paramete in the form

$$\mathcal{U}_C = -[V_{CR} + iV_{CI}]\,\rho(r) + [V_{SR} + iV_{SI}]\left(\frac{\hbar}{\mu c}\right)^2 \frac{1}{r}\frac{d\rho}{dr}\sigma\cdot l,$$

and experiments necessary to determine the four parameters V_{CR}, V_{CI}, V_{SR} and V_{SI} are discussed. The explicit relation between the parameters and nucleon–nucleon scattering amplitudes are given and existing experimental data are reviewed. The phase shifts of Feshbach and Lomon have been used to calculate V_{CR}, V_{SR}, and V_{SI}. These values seem to reprodu the qualitative features of the "measured" values of these qua tities. (A quantitative comparison is not possible, since anal yses of the experimental data are not sufficiently complete.) A

539.172.1

6152. REACTION $Al^{27}(p, 3pn)Na^{24}$. H.G.Hicks, P.C.Stevens and W.E.Nervik.
Phys. Rev., Vol. 102, No. 5, 1390-2 (June 1, 1956).

The cross-section was measured as a function of proton energy between 32 and 350 MeV by comparison with the cross section of the reaction $C^{12}(p, pn)C^{11}$. A

539.172.1

6153. ELASTIC SCATTERING OF 5.25-MeV PROTONS FROM Co, Ni, Cu, AND Zn. D.A.Bromley and N.S.Wall.
Phys. Rev., Vol. 102, No. 6, 1560-7 (June 15, 1956).

The angular distributions of 5.25 MeV protons scattered by natural targets of elements with Z = 27 through Z = 30 hav been measured. All angular distributions show a minimum in the differential cross-section relative to Coulomb scattering at about 85°. The Ni and Zn relative cross-sections then rise linearly whereas there is no systematic behaviour for the Co and Cu. The Cu relative cross-section has maxima at about 45° and 130° and the Co has a region of approximately constan relative cross-section at large angles. The angular distribution for Ni has been fitted by Saxon using a complex potential well; however, when one uses the same parameter for Co, Cu and Zn, essentially no agreement is found. A

539.172.1

6154. INELASTIC SCATTERING OF PROTONS FROM Cl^{35} AND Cl^{37}. J.P.Schiffer, C.R.Gossett, G.C.Phillips and T.E.Young.
Phys. Rev., Vol. 103, No. 1, 134-5 (July 1, 1956).

The Rice Institute 180° magnetic spectrometer was used in measuring the energies of inelastically scattered protons from targets of normal KCl and from NaCl targets enriched in Cl^{35} and Cl^{37}. Bombarding energies of 4.6, 4.7, 4.8, 5.0 and 5.6 MeV were used. One state of 1.713 ± 0.010 MeV was observed in Cl^{37} and two states at 1.220 ± 0.005 and 1.766 ± 0.005 MeV are assigned to Cl^{35} for energies of excitation below 2 MeV. No state below 2.0 MeV excitation was observe in K^{39}, while the first excited state of Na^{23} was determined as 437 ± 5 keV. A

539.172.13

.55. INTERPRETATION OF THE $H^3(p,n)$ REACTION. .Selove.

nys. Rev., Vol. 103, No. 1, 136-41 (July 1, 1956).

The angular and energy dependence of the $H^3(p,n)$ reactn at energies up to a few MeV have been much analysed for eir possible indication of resonances in the "compound nueus" He^4. It is shown that the experimental data can be exained on the basis of "direct" interactions, without assuming at any compound-nucleus state is involved. A combination of nock-on" and "pick-up" effects is involved. In addition to moving the $H^3(p,n)$ data as evidence for an excited state of e^4, the result of this work adds to previous evidence that the orn approximation can give a good account of the angular and nergy variations in nuclear rearrangement collisions, even t energies as low as a few MeV. A.

539.172.13

156. FISSION OF BISMUTH WITH 15- AND 22-MeV EUTERONS. A.W.Fairhall.

hys. Rev., Vol. 102, No. 5, 1335-40 (June 1, 1956).

Radiochemical studies of bismuth bombarded with 15 and 2 MeV deuterons give evidence of fission product species, learly distinguishable from species arising from activation target impurities. The mass-yield curve of fission products om bismuth bombarded with 22 MeV deuteron is unlike the ouble-humped curves of the heavier elements ($Z \geq 90$) excited comparable energies: it is single humped, symmetric about ass 103.5 and quite narrow. The width of the curve at half-aximum is only 17 mass units. The cross-sections for fision of bismuth by 20 MeV deuterons is estimated to be about $\times 10^{-29}$ cm^2, and for 15 MeV deuterons about 4×10^{-31} cm^2. he competition between fission and neutron evaporation in igh-energy fission is discussed. A.

539.172.13

157. STATES OF LOW EXCITATION IN O^{18}. D.R.Bach nd P.V.C.Hough.

hys. Rev., Vol. 102, No. 5, 1341-4 (June 1, 1956).

A new state in O^{18} at an excitation energy of 3.555 ± 0.013 leV is established by a proton group from the reaction $O^{17}(d,p)$ ith $Q = 2.262 \pm 0.015$ MeV and by a deuteron group from the eaction $O^{18}(d,d')$ with $Q = -3.551 \pm 0.019$ MeV. A level reorted by Ahnlund at 1.986 ± 0.014 MeV is confirmed. No evience is found for states between these two, in particular for ne reported by Holmgren and coworkers at 2.445 MeV. A.

539.172.13

158. COMPOUND NUCLEUS EFFECTS IN DEUTERON EACTIONS: $C^{13}(d,\alpha)B^{11}$ AND $C^{13}(d,t)C^{12}$. J.B.Marion and .Weber.

hys. Rev., Vol. 102, No. 5, 1355-64 (June 1, 1956).

Excitation functions for the $C^{13}(d,\alpha)B^{11}$ and $C^{13}(d,t)C^{12}$ eactions have been measured at several laboratory angles in ne range of deuteron energy from 1 to 3 MeV. Two prominent esonances were observed in the (d,α) reaction at 1.80 MeV ($\Gamma = 55 \pm 10$ keV) and at 2.20 MeV ($\Gamma = 22 \pm 4$ keV). The latter esonance was observed at 14 angles of observation from 25° o 140°. The 1.80 MeV resonance was observed at 9 angles in ne (d,α) reaction and at 3 angles in the (d, t) reaction. The .20 MeV resonance was not found in the (d, t) reaction, but the -particle group leaving B^{11} in the first excited state was oberved to be resonant at this energy. Both of the narrow esonances exhibit striking interference effects with the nonesonant background. An analysis of the interference effects t the 2.20 MeV resonance indicates that deuterons with 3 or units of angular momentum are responsible for the formation f the corresponding N^{15} level. The differential cross-section or the (d,α) reaction was measured at 17 angles from 11.2° to 44.6° (c.m.) at $E_d = 2.28$ MeV. Terms at least as high as $\cos^4\theta$ are necessary to fit the forward peak. This forward eaking in the (d,α) reaction persists over the entire energy ange studied in spite of the large number of resonances in this region. This behaviour suggests that some of the approximations usually made in the theory of highly excited states of nuclei are not of general validity. A.

539.172.13

6159. MAGNETIC ANALYSIS OF THE INELASTICALLY SCATTERED DEUTERONS AND DISINTEGRATION PROTONS FROM THE DEUTERON BOMBARDMENT OF FLUORINE. F.A.El Bedewi.

Proc. Phys. Soc. A, Vol. 69, Pt 3, 221-33 (March, 1956).

A magnetic spectrograph with photographic detection has been used to analyse the spectra of charged particles emitted from the bombardment of a thin teflon target by 8.9 MeV deuterons. Angular distribution measurements are also reported for several proton and deuteron groups produced in this bombardment. Two inelastically scattered deuteron groups corresponding to excited states in F^{19} at 1.60 ± 0.02 MeV and 2.83 ± 0.02 MeV have been observed. The angular distribution of the former group is compared with a theory proposed by Huby and Newns. A number of proton groups have been assigned to the $F^{19}(d,p)F^{20}$ reaction. Eight new excited states in F^{20} are observed at 5.04, 5.19, 5.27, 5.72, 5.87, 5.95, 6.25 and 6.52 MeV, with errors of ± 0.02 MeV. The deuteron stripping theories have been applied to determine the l_n-values as well as the reduced widths of 21 excited states in F^{20}. The general behaviour of the energy levels of this nucleus is discussed. The angular distribution of a proton group associated with the transition to the 6.091 MeV level in C^{14} is found to have $l_n = 0$. A possible configuration for this state is $(1p_{1/2})^1(2s_{1/2})^1$. A.

539.172.13

6160. THE CROSS SECTION AND ANGULAR DISTRIBUTIONS OF THE D–D REACTIONS BETWEEN 40 AND 90 keV. D.L.Booth, G.Preston and P.F.D.Shaw.

Proc. Phys. Soc. A, Vol. 69, Pt 3, 265-70 (March, 1956).

A thin gas target was used for measurements of the cross-sections and angular distributions of the He^3 and H^3 disintegration products at bombarding energies of 52 and 87 keV, two symmetrically placed proportional counters being used as detectors. The angular range covered was from 18° to 150° in the laboratory coordinate frame. In addition, the ratio of the differential cross-sections of the reactions was measured for a laboratory angle of 48° at bombarding energies of 39 and 65 keV. The results obtained are consistent with earlier measurements using the same technique, and show that the neutron-producing reaction has the greater anisotropy, and that the ratio of the total cross-sections is energy dependent. A.

539.172.13

6161. AN INVESTIGATION OF DEUTERON INDUCED REACTIONS BY MAGNETIC ANALYSIS. III. RESULTS FOR NEON AND ARGON. H.B.Burrows, T.S.Green, S.Hinds and R.Middleton.

Proc. Phys. Soc. A, Vol. 69, Pt 4, 310-17 (April, 1956).

For Pt II, see Abstr. 3219 (1956). The energy spectra of the protons emitted from targets of natural neon and argon when bombarded by 8.5 MeV deuterons have been measured by magnetic analysis and in both cases several levels not previously reported have been observed. The angular distributions of nine proton groups from Ne^{20}, two groups from Ne^{22} and eight groups from A^{40} have been measured. In most cases these have been fitted with theoretical stripping curves enabling the following spin and parity assignments to be made: Ne^{21} ground state (isotropic) 0.35 MeV (3/2 or $5/2^+$), $2.78(1/2^+)$, $4.58(3/2$ or $5/2^+)$ $4.81(1/2, 3/2^-)$, $5.43(3/2, 5/2^+)$, $5.63(3/2, 5/2^+)$, $5.78(1/2, 3/2^-)$, $6.72(3/2, 5/2^+)$ Ne^{23} ground state $(3/2, 5/2^+)$, $0.98(1/2^+)$. A^{41} ground state $(5/2, 7/2^-)$, 0.57, 1.39, 2.46, 2.79, 3.01, 3.36, 3.98 (all $1/2, 3/2^-$). A.

539.172.13 : 539.185

6162. NEUTRON SPECTRA IN THE BOMBARDMENT OF TRITIUM AND DEUTERIUM BY 14 MeV DEUTERONS. G.F.Bogdanov, N.A.Vlasov, S.P.Kalinin, B.V.Rybakov and

V.A.Sidorov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 185-7 (1956). In Russian.

Neutrons from the target are measured by a time-of-flight mechanism. A group of neutrons with energy corresponding to the Q-value −5 MeV in the $T(d,n)He^4$ reaction is observed, but later experiments (reported here) with deuterons on deuterium indicate that these are neutrons from a stripping reaction. G.E.Brown

539.172.13

6163. DISINTEGRATION OF RELATIVISTIC DEUTERONS IN THE ELECTRIC FIELD OF THE NUCLEUS.
L.N.Rozentsveĭg and A.G.Sitenko.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 427-8 (1956). In Russian.

Dancoff's stripping treatment for high energies ($\gtrsim$ 200 MeV) is extended by a relativistic treatment of the deuteron centre-of-mass motion. G.E.Brown

539.172.3

6164. ANGULAR DISTRIBUTION OF NEUTRONS FROM THE $Be^9(\gamma,n)Be^8$ REACTION. W.Czyż.
Phys. Rev., Vol. 102, No. 4, 1185 (May 15, 1956).

The differential cross-section calculation of Guth and Mullin (see Abstr. 2673/1950) has been extended to take account of interference between the possible electric dipole transitions. M.A.Grace

539.172.4

6165. NEUTRON-CAPTURE CROSS SECTION OF ACTINIUM-227. H.W.Kirby, G.R.Grove and D.L.Timma.
Phys. Rev., Vol. 102, No. 4, 1140-1 (May 15, 1956).

In the production of actinium-227 by thermal neutron irradiation of radium-226, thorium-228 has been recovered as a by-product. The reactions involved are: $Ra^{226}(n,\gamma)Ra^{227} \rightarrow Ac^{227} + \beta^-$, and $Ac^{227}(n,\gamma)Ac^{228} \rightarrow Th^{228} + \beta^-$. The thermal neutron capture cross-section of actinium-227 is 495 ± 35 barns, as determined by the pile oscillation method. The half-life of thorium-228, determined by daily alpha counting for two years, is 697.8 ± 0.7 days or 1.910 ± 0.002 year. A.

539.172.4

6166. COHERENT NEUTRON SCATTERING AMPLITUDES OF KRYPTON AND XENON, AND THE ELECTRON–NEUTRON INTERACTION. M.F.Crouch, V.E.Krohn and G.R.Ringo.
Phys. Rev., Vol. 102, No. 5, 1321-24 (June 1, 1956).

The coherent scattering amplitudes of krypton and xenon for thermal neutrons have been measured by a comparison method involving reflection of a neutron beam from liquid mirrors. The results were (7.68 ± 0.19) x 10^{-13} cm for krypton and (5.10 ± 0.17) x 10^{-13} cm for xenon. When these results are used with the scattering measurements of Hamermesh, Ringo and Wattenberg, one obtains (3900 ± 800) eV for the electron–neutron interaction. A.

539.172.4

6167. TOTAL CROSS SECTIONS OF LIGHT ELEMENTS FOR (α, n) NEUTRONS. R.L.Becker and H.H.Barschall.
Phys. Rev., Vol. 102, No. 5, 1384-9 (June 1, 1956).

The usefulness of the $Be^9(\alpha,n)$ and the $C^{13}(\alpha,n)$ reactions as sources of monoenergetic neutrons of variable energy was investigated. Measurements of the yield of the $C^{13}(\alpha,n)$ reaction are presented. Total cross-sections for elements of atomic number from 3 to 9 were measured for neutron energies between 4.4 and 5.6 MeV and between 7.6 and 8.6 MeV. The results give some information about energy levels in C^{13} and O^{17}. A.

539.172.

6168. NEUTRON-INDUCED CHARGED PARTICLE REACTIONS IN POTASSIUM-39. M.J.Scott and R.E.Segel.
Phys. Rev., Vol. 102, No. 6, 1557-9 (June 15, 1956).

Thin thallium-activated potassium iodide crystals were exposed to monoenergetic neutrons ranging in energy from 2.0 to 5.5 MeV. Pulse-height spectra were taken of the scintillations in the crystal. Five charged particle groups were observed, three (n, p) reactions leading to states in A^{39}, and two (n, α) reactions leading to states in Cl^{36}. A new level was discovered at 2.46 ± 0.1 MeV in A^{39}, and the level at about 1.25 MeV in A^{39} confirmed. Yield curves were measured for three of the groups. A

539.172.

6169. NEUTRON RESONANCES IN THE keV REGION.
J.H.Gibbons.
Phys. Rev., Vol. 102, No. 6, 1574-9 (June 15, 1956).

A neutron collimation-detection system has been constructed for use in measurements of resonance neutron cross-sections. The high efficiency of the detector in combination with careful collimator design enables one to collect data with relatively good resolution in a short time. Although designed to measure cross-sections at a minimum energy of about 5 keV, resonances have been observed at energies as low as 350 eV. Resolving power exceeds that of velocity selectors, however, only at neutron energies greater than about 5 keV. Resonances in iron were found at 8, 29, 75 and 85 keV. The three latter resonances exhibit strong interference dips and are assumed to be due to s-wave neutrons on Fe^{56}. The resonance energies found in bismuth were 1, 3, 13, 16, 34, 47 and 70 keV; the level spacing for a single J value thus seems to be about 20 keV. A

539.172.4

6170. NEUTRON RESONANCES IN THE keV REGION: HEAVY EVEN ELEMENTS. H.W.Newson, J.H.Gibbons, H.Marshak, R.M.Williamson, R.A.Mobley, A.L.Toller and R.Block.
Phys. Rev., Vol. 102, No. 6, 1580-3 (June 15, 1956).

Neutron cross-section curves as a function of neutron energy have been measured for Se(1-80), Sr(6-102), Zr(2-80), Mo(1-80), Ba(15-102), Ce(5-55) and Pb(2-80); the energy range in keV of each curve is shown in parentheses. The number of peaks observed are 8, 4, 11, 9(?), 5, 12 and 10, respectively. Isotopic assignments of a few of the observed resonance peaks are Se^{80}; 3 and 7 keV; Sr^{88}; 15 and 95 keV; Zr^{90}; 43 keV; and Ce^{140}; 24 keV. No doubt many peaks, particularly those due to minor isotopes, have been missed completely. It is concluded that many of the nuclides which make up these complicated isotropic mixtures would be found to have strong, well separated resonances if they were measured in an isotopically pure state with a neutron energy spread of the order of a few keV. A

539.172.

6171. EXPERIMENTS ON THE INELASTIC SCATTERING OF NEUTRONS BY URANIUM. R.Batchelor.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 214-20 (March, 1956).

A He^3 neutron spectrometer has been used to study the spectrum of neutrons inside a spherical uranium shell, 3 cm thick, when the latter is bombarded with monoenergetic neutrons of various energies between 500 keV and 1.0 MeV. The spectra of neutrons scattered inelastically and also the cross sections for this process have been derived, and the results compared with those predicted by current nuclear theory. Evidence for the existence of the low-lying rotational levels of U^{238} is presented, and at least one new level at 700 keV (and possibly more at higher energies) has been found. Qualitative confirmation has been obtained by measuring the spectrum of neutrons from a uranium shell, 11.5 cm thick, with a neutron source in the centre. A

539.172.4

6172. THERMAL-NEUTRON FISSION CROSS SECTION OF Pu^{240}. E.K.Hulet, H.R.Bowman, M.C.Michel and R.W.Hoff. Phys. Rev., Vol. 102, No. 6, 1621 (June 15, 1956).

A thermal-neutron fission cross-section of 4.4 ± 0.5 barns for isotopically pure Pu^{240}, formed by the β^- decay of U^{240}, has been measured in the thermal column of the Materials Testing Reactor. A.

539.172.4

6173. EFFECTIVENESS OF CONTROL RODS IN A CYLINDRICAL REACTOR. A.Ascari. Energia nucleare, Vol. 2, 272-83 (April, 1955). In Italian.

The effectiveness of a system of cylindrical control rods, inserted parallel to the axis in a cylindrical thermal reactor, is evaluated. The systems under examination consist either of a single central rod or of a concentric ring of equally spaced rods. In this paper is considered the dependence of the control-rod effectiveness upon the following parameters: dimensions of reactor (typical values for natural-uranium, heavy-water reactors); radius of rods; number of rods and radius of ring. The effect of partial insertion is also estimated. A.

539.172.4

6174. THE DYNAMICS OF REFLECTED THERMAL REACTORS. I. A.Ascari and L.Orsoni. Energia nucleare, Vol. 2, 345-64 (June, 1955). In Italian.

The calculation, using a method outlined by Rumsey, of the two basic dynamical parameters of a thermal nuclear reactor, namely the generation time and the effective multiplication factor, for a reflected reactor. An analysis of the assumptions which simplify the calculations is given, and the generation time, both with one- and two-group theory is calculated. A.

539.172.4

6175. THE DYNAMICS OF REFLECTED THERMAL REACTORS. II. A.Ascari and L.Orsoni. Energia nucleare, Vol. 2, 438-53 (Aug., 1955). In Italian.

An example of numerical calculation of the dynamical parameters, involved (i.e. the generation time and the effective multiplication factors) is given for a cylindrical reactor, radially reflected. A.

539.172.4

6176. A CRITERION FOR CALCULATING A HEAVY-WATER HETEROGENEOUS REACTOR. S.Gallone. Energia nucleare, Vol. 2, 434-7 (Aug., 1955). In Italian.

A method similar to that of Atkinson and Murray for optimizing the multiplication factors of heterogeneous reactors has been applied to the determination of "optimum" lattice parameters in a natural uranium-heavy-water reactor. A.

539.172.4

6177. COMPOSITION OF THE FUEL ELEMENT DURING THE OPERATION OF A THERMAL HETEROGENEOUS NATURAL URANIUM REACTOR. L.Mongini and C.Mongini Tamagnini. Energia nucleare, Vol. 2, 519-36 (Oct., 1955). In Italian.

The growth of the fission products (exclusive of Xe^{135} or Sm^{149}) with time, for average fluxes in uranium of 10^{12} neutrons/cm^2 sec and 10^{13} neutrons/cm^2 sec, is evaluated. It is thus possible to calculate the dependence of the total macroscopic absorption cross-section of the fission products on time of irradiation. In addition, equations relating the atomic fractions of the various nuclides in the fuel to the time of irradiation are derived. Finally, the dependence of the operational time of a reactor upon the following parameters is shown: the average flux in uranium; a microscopic absorption cross-section per each original fuel atom, which must artificially allow for the absorption of structural materials, moderator, Xe^{135}, Sm^{149}, control devices, and for neutron leakage. This microscopic absorption cross-section, through the neutron leakage, is closely related to the reactor size. A.

539.172.4

6178. RADIOACTIVE SPECIES INDUCED IN REACTOR COOLING WATER. W.S.Lyon and S.A.Reynolds. Nucleonics, Vol. 13, No. 10, 60-2 (Oct., 1955).

The activities induced in water flowing over Al, stainless and carbon steels and cast iron, were examined with a proportional beat counter and a NaI gamma-ray spectrometer. The main beta-activity was that of N^{16} formed in the $O^{16}(n, p)$ reaction. The other activities identified were Na^{24}, Mg^{27}, Al^{28}, Mn^{56}, Cu^{64} and Ag^{110}. L.R.Shepherd

539.172.4

6179. THERMAL-NEUTRON DIFFUSION LENGTHS FOR WATER, LUCITE, FURFURAL, AND AN EXPANDED PLASTIC. L.R.Heintzé. Nucleonics, Vol. 14, No. 5, 108, 110, 112, 114-15 (May, 1956).

The neutron flux distribution in cylindrical samples 8¾ in. diameter was measured with indium foils, using a graphite pedestal on the BNL thermal column as a source. The effects of epithermal neutrons were eliminated by measuring foil activation ratios with and without a Cd foil between source and sample. The measured diffusion lengths were: water 2.86 cm, Lucite 3.14 cm, furfural 5.57 cm and the expanded plastic ($\rho = 0.504$) 6.73 cm. The average value of the transport cross-section of hydrogen calculated from these results is 33 barns. R.D.Smith

539.172.4 : 621-5

6180. RECENT PROGRESS IN THE CONTROL OF REACTORS. J.Weill. Onde élect., Vol. 35, 867-87 (Oct., 1955). In French.

Gives a detailed description of neutron monitoring ionization chambers and the associated d.c. amplifiers, and discusses how these can be used in automatic systems to control the pile power. J.M.Cassels

539.172.5

6181. CONCEPTUAL DESIGN FOR INTERNALLY COOLED LMFR. R.J.Teitel. Nucleonics, Vol. 14, No. 4, 72-7 (April, 1956).

Design study for a graphite-moderated Th^{232}-U^{233} power breeder reactor producing 500 MW heat. A dispersion of Th_3Bi_5 in Bi is used both as a coolant and as a breeding blanket. The core consists of a dispersion of 1.77% wt of USn_3 in a Pb–Bi–Sn alloy contained in vertical graphite U-tubes. The reactor contains 110 kg U^{233} (64 kg in core) 34.6 tons Th and 424 tons of Bi. Data is given for the design of the core, blanket and heat exchanger and possible processing methods are discussed. The estimated breeding ratio for such a reactor is 1.17. R.D.Smith

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

6182. HEAVY MESONS AND HYPERONS IN NUCLEAR EMULSION. H.Winzeler, M.Teucher and E.Lohrmann. Helv. phys. Acta, Vol. 29, No. 1, 75-82 (March, 1956). In German.

During the scanning of 100 cm^3 of nuclear emulsion exposed at high altitude 16 τ-mesons and 4 τ'-mesons, and 3 hyperons decaying at rest have been found. The mean Q-value for the decay of the τ-meson has been determined as 73.8 ± 1.2 MeV, which leads to a value of 962.5 ± 2.5 m_e for the mass. The distribution of the angle between the meson direction and its decay plane is isotropic. The mean size of the parent stars is 15 + 5.6, in agreement with previous work. The hyperons are all probably $\Sigma^{\pm}$-hyperons; two decaying in the $p + \pi^0$ mode and the other in the $n + \pi^-$ mode. D.J.Prowse

539.18

6183. PROBABLE EVIDENCE FOR Yρ-EVENTS.
C.Castagnoli, C.Franzinetti and A.Manfredini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1159-61 (May, 1956).

A systematic search has been made for hyperons coming to rest and giving rise to no decay product or visible prong (Yρ-events). Mass measurements were made by the average gap-length versus range method on a large number of particles emitted from stars found in emulsions exposed to cosmic radiation. Two probable examples have been found. They can be interpreted as $\Sigma^- + P \rightarrow \Lambda^0 + N$, or $\Sigma^0 + N$; or as $\Xi^- + P \rightarrow \Lambda^0 + \Lambda^0$ or $\Xi^0 + N$. From the mass measurements (2500 ± 160 and 2740 ± 100 m_e) both are more likely to be Ξ^--hyperons. Considering the statistical weights of the final reaction states, the reaction is most probably, $\Xi^- + P \rightarrow \Lambda^0 + \Lambda^0$. D.J.Prowse

539.18

6184. ASSOCIATED PRODUCTION AND THE LIFETIMES OF THE Λ^0 AND θ^0 PARTICLES. H.Blumenfeld, E.T.Booth, L.M.Lederman and W.Chinowsky.
Phys. Rev., Vol. 102, No. 4, 1184-5 (May 15, 1956).

Preliminary report of work on the 36 in. Colombia magnet cloud-chamber at the cosmotron. The 1.9 BeV π-meson beam produces unstable particles in ¼ in. carbon plates inside the chamber. 95 Λ^0 and 29 θ^0 decays have been observed to date, giving lifetimes $(28 \pm {}^{0.5}_{0.4}) \times 10^{-10}$ sec and $(0.8 \pm {}^{0.3}_{0.2}) \times 10^{-10}$ sec respectively. A set of Λ^0 events was chosen excluding (with high probability) (i) associated production of K^+ and (ii) associated θ^0 decaying into charged π-mesons in the plate of origin. Among 28 such events only 7 associated θ^0 decays were observed. To account for this it is suggested that (i) $\theta^0 \rightarrow 2\pi^0$ is possible and/or (ii) the associated neutral partner of Λ^0 has either a neutral decay mode or a long lifetime ($> \sim 10^{-9}$ sec). R.H.W.Johnston

539.18

6185. ANGULAR CORRELATION IN NEW UNSTABLE PARTICLE DECAYS. B.V.Sreekantan, G.Sandri and A.Pevsner.
Phys. Rev., Vol. 103, No. 1, 240-3 (July 1, 1956).

Among the cosmic-ray events recorded with a multiplate cloud chamber there are twelve in which two of the new unstable particles (hyperons or heavy mesons) seem to originate in the same nuclear interaction inside the chamber. Seven events show two neutral V particles, four show one neutral and one charged V, and one a neutral V and an S particle. The histogram of the dihedral angle between the production and decay planes of the unstable particles is found to be consistent with a uniform distribution. This result does not necessarily imply small spin for the new unstable particles. A.

539.18

6186. A NEGATIVE-PROTON-INDUCED STAR OBSERVED IN NUCLEAR EMULSION. O.Chamberlain, W.W.Chupp, G.Goldhaber, E.Segrè, C.Wiegand, E.Amaldi, G.Baroni, C.Castagnoli, C.Franzinetti and A.Manfredini.
R.C. Accad. Naz. Lincei, Vol. 19, No. 6, 381-6 (Dec., 1955). In Italian.

Details are given of measurements of the energy liberated in the star (826 MeV visible and ~ 160 MeV invisible). Five independent measurements on the primary particle give a weighted mean mass 1824 ± 51 m_e, the most accurate determination being by the momentum–range method. R.H.W.Johnston

539.18

6187. MESONIC DECAY IN FLIGHT OF A TRITON HYPERFRAGMENT. O.Skjeggestad and S.O.Sørensen.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 652-4 (March, 1956).

A three-prong event associated with a 23 + 3p type star in emulsion exposed to cosmic rays is interpreted as ${}^5H^* \rightarrow {}^4H + {}^1H + \pi^-$. All the secondary particles stop in the emulsion and it is possible to calculate a binding energy of 1.4 ± 1.0 MeV for the Λ^0. It is possible to exclude the possibility that the excited fragment is ${}^5H^*$. R.H.W.Johnston

539.18

6188. THE DECAY OF BOUND Λ^0-PARTICLES. G.Eder.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 880-4 (May, 1956). In German.

The proton spectra expected from the decay of bound Λ^0-particles have been calculated on the basis of a simple model. Because the Λ^0-particle is confined within the nuclear radius, the maximum and minimum proton energies are about 12 and 1 MeV respectively; the peak of the distribution being centred about the energy expected from the true two-body decay (5.1 M for a binding energy of 1 MeV). A curve is given for Z = 3 taking the potential of the Λ^0 in the nuclear well as 7.7 MeV. There is a sharp rise from 0 to 5 MeV and an even sharper fall just beyond 5 MeV producing a tail to the distribution which finally reaches zero between 15 and 25 MeV. D.J.Prowse

539.18

6189. A τ-DECAY WITH A SECONDARY OF EXTREMELY LOW ENERGY. N.Brene.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1140-1 (May, 1956).

In the course of an analysis of K secondaries in emulsion exposed to the Bevatron, a τ-decay was observed which included a π^+ of range 12 microns only. R.H.W.Johnston

539.18

6190. RATIOS OF DECAY MODES OF K^+ MESONS PRODUCED BY THE COSMOTRON. T.F.Hoang, M.F.Kaplon and G.Yekutieli.
Phys. Rev., Vol. 102, No. 4, 1185-7 (May 15, 1956).

164 K^+ and 9 τ^+ decays were found by "along the track" scanning of emulsion exposed to the Cosmotron K^+ beam. The secondaries of the former were classified according to dip and ionization. 12 tracks were visually classed as "ionizing" and were identified as 6 π- and 6 μ-mesons. 42 of the remaining 152 had dip $< 15^0$ and were classified by blob-counting. 31 had blob-density $\bar{g} < 1.08$ and 11 had $1.08 < \bar{g} < 1.30$. Ionizations were measured relative to 1.5 BeV π-meson tracks. A further classification enabled the following estimates of the branching ratios to be made:

	$K_{\mu 2}$	$K_{\pi 2}$	τ	$K_{\pi 3}$	$K_{\mu 3}$	K_{e3}
%	59-65	21-24	5.2	3.5	6-9	5-11

R.H.W.Johnston

539.18

6191. DECAY MODES OF NEGATIVE K-MESONS.
A.G.Ekspong and G.Goldhaber.
Phys. Rev., Vol. 102, No. 4, 1187-8 (May 15, 1956).

In the course of a study of K^- interactions and lifetime in emulsions two decays in flight were observed for which it was possible to establish the decay scheme. Blob-density and scattering measurements on the secondary tracks enabled the modes $K_{\pi 2}$ and K_{e3} to be identified. R.H.W.Johnston

539.18

6192. ON Λ^0-BINDING ENERGIES IN HYPERFRAGMENTS.
T.Tati and H.Tati.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1136-9 (May, 1956)

The qualitative differences between the Λ^0 binding energies, $B_\Lambda(A)$, and the nucleon separation energies are pointed out. The former are expected to lie on a smooth curve while the latter vary with N and Z in a complicated way governed by the Pauli principle. $B_\Lambda(A)$ is estimated assuming a simple model. It is suggested that if the theory is true it may be used to decide between alternative decay schemes in events whose interpretations are ambiguous. R.H.W.Johnston

539.18

93. ON THE MASS OF THE K⁻-MESON. F.Hänni, Lang, M.Teucher, H.Winzeler and E.Lohrmann.
iovo Cimento (Ser. 10), Vol. 3, No. 5, 1169-70 (May, 1956).
An elastic scatter of a negative K-meson by a free proton is observed in emulsion exposed to cosmic rays. This enabled the mass of the K-meson to be determined with some curacy: $m_{K^-} = 979 \pm 11\ m_e$. R.H.W.Johnston

539.18

94. A POSSIBLE METHOD FOR DETERMINING THE INS OF THE Σ AND OF THE Λ. R.Gatto.
iovo Cimento (Ser. 10), Vol. 3, No. 3, 665-8 (March, 1956).
The spin of the Σ^0 and the Λ^0 can be determined from the gular correlations between the line of flight of the Λ in the cay $\Sigma^0 \to \Lambda^0 + \gamma$ and the direction of the decay products of e Λ in its own rest system. P.T.Matthews

539.18

95. SPIN AND PARITY ANALYSIS OF BEVATRON τ ESONS. J.Orear, G.Harris and S.Taylor.
iys. Rev., Vol. 102, No. 6, 1676-84 (June 15, 1956).
The data of 71 τ^+ decays found in emulsions exposed at the evatron are presented and analysed. These data are free om selection bias favouring short-ranged pions. Of these events, 13 have negative pions under 10 MeV and one event is a π^+ of (0.38 ± 0.03) MeV. Assuming the distribution nctions proposed by Dalitz, the relative probabilities that the events turn out the way they did are 1, $10^{-7.9}$, $10^{-33.5}$, $10^{-8.8}$, $10^{-10.5}$, and $< 10^{-2}$ for the respective (0−), (1+), (1−), (2+), (2−) and (3+) spin and parity configurations. The (0−) distribution function of Dalitz is statistically a good fit to the data. addition, 55 Massachusetts Institute of Technology and 00 Berkeley τ decays are shown to behave essentially the same ay. No indication of polarization of the Bevatron τ beam was und. Conclusions are drawn from the data that the τ and mesons have different spin-parity configurations and that the ily reasonable possibilities for the τ are (0−) and (2−). The ita are also used to give an upper limit for the s-wave pion– on interaction. A.

539.18

196. CHARGE EXCHANGE OF K-MESONS IN HYDROGEN ND DEUTERIUM. L.B.Okun'.
h. éksper. teor. Fiz., Vol. 30, No. 1, 218-19 (1956). In ussian.
Comparison of the cross-sections in hydrogen and deuterm can give information about the spins and parities of -mesons. G.E.Brown

539.18

197. SOME CONSIDERATIONS ON THE PHASE SHIFT NALYSIS IN THE (p⁺–p⁺) SCATTERING. G.Puppi and .Stanghellini.
uovo Cimento (Ser. 10), Vol. 3, No. 2, 491-5 (Feb., 1956).
In order to clarify the pion–nucleon scattering process e authors examine the T = 3/2 state by means of pion–nucleon xperimental data referring to a particular charge state. arious Chicago data on angular distributions and total cross-ection data from Pittsburgh and Brookhaven referring to the + charge state were used to compute the phases θ_3, θ_{13}, θ_{31}, $_{33}$, as a function of energy in the range of 0-189 MeV. At low nergy it was assumed that S-phases vary with the first and -phases with the third power of momentum. At low energies e authors found agreement with results obtained by means of experiments. Further discussion of the results attempts to emove some of the ambiguities of phase determination by ppeal to Wigner's causal principle (see Abstr. 4376/1955). H.Motz

539.18

198. DISPERSION RELATIONS FOR PION–NUCLEON CATTERING: NO-SPIN-FLIP AMPLITUDE. R.Oehme.
hys. Rev., Vol. 102, No. 4, 1174-80 (May 15, 1956).
It is shown that the principle of microscopic causality is sufficient and in general also necessary for the existence of dispersion relations for the derivatives of the no-spin-flip amplitude with respect to $\cos\theta$, taken at zero angle. Physical dispersion relations are derived for these quantities, neglecting the nucleon recoil. The dispersion formulae for the first derivative reduce to the no-spin-flip parts of Low's P-wave equations, if one neglects in addition to the recoil all inelastic processes and contributions from partial waves with $l > 1$. In combination with corresponding approximate relations, obtained from the exact dispersion formulae for the forward scattering amplitude, one can derive integral equations for S-waves only. The inhomogeneous terms of these equations contain the zero-energy scattering lengths. Finally, it is shown that in general one cannot derive normal dispersion relations for the amplitudes corresponding to individual angular momenta. A.

539.18

6199. EVALUATION OF THE $\pi^+ - p$ SCATTERING CROSS-SECTION FROM THE $\pi^- - d$ SCATTERING NEAR RESONANCE. Yu.A.Gol'fand.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 413-14 (1956). In Russian.
Because of charge independence, the $\pi^+ - p$ cross-section is the same as the $\pi^- - n$ one, which can be obtained approximately as $\sigma(\pi^-d) - \sigma(\pi^-p)$. The correction for the internal motion of the deuteron is calculated here, and found to decrease this difference ~10% from the true $\sigma(\pi^-n)$ at resonance. G.E.Brown

539.18

6200. REMARKS ON THE ABSORPTION OF NEGATIVE K-MESONS BY PROTONS. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1142-4 (May, 1956).
The possible behaviour of a bound K^--particle is considered: (a) $K^- + p \to Y + \pi$. The relative frequency of Σ and Λ production is estimated to be about 3 : 1. (b) charge exchange requires a mass difference between initial and final K-particles > 1.3 MeV. (c) transformation of K_1^- into a possible K_2^- requires a mass difference $> \sim 10^4$ eV only. Reaction (a) above is expected to be the most probable. Observationsof the hyperons produced in (a) may give spin information. It is pointed out, however, that (unlike the case of π^- capture) direct 2p absorption of K^- can compete with the 2p → 1s transition, rendering the hyperon spin problem more difficult. R.H.W.Johnston

539.18

6201. CONSEQUENCES OF CHARGE INDEPENDENCE FOR STRANGE-PARTICLE REACTIONS. D.Feldman.
Phys. Rev., Vol. 103, No. 1, 254-7 (July 1, 1956).
The implications of isotopic-spin conservation for fast strange-particle reactions, especially the production processes as well as the K-particle interactions with nuclei, have been investigated. The possibility of distinguishing the Gell-Mann, Pais, and Salam–Polkinghorne theories of strange particles is also discussed. A.

539.18

6202. PRODUCTION OF A HYPERFRAGMENT BY THE CAPTURE OF A NEGATIVE HYPERON. P.Rosselet, R.Weill and M.Gailloud.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 505-9 (Feb., 1956). In French.
A 10 + 5n star gave rise to a particle which forms a 3-prong capture star after travelling a distance of 2.31 mm. One of the prongs is thought to be a hyperfragment, $^4H^*$. It decays into a π^--meson of 30 MeV and what could be a ^{3}He of 0.9 MeV. These two tracks are not collinear and the ejection of a neutron has to be assumed in order to balance momentum giving the decay scheme of: $^4H^* \to {}^3He + n + \pi^-$. The Q-value is then 34.9 ± 0.5 MeV giving a binding energy for the Λ^0 of

A

1.2 ± 0.7 MeV. The mass of the particle producing this capture star has been determined as 2270 ± 110 M_e and identified as a Σ^- hyperon. Assuming the capture reaction to be $\Sigma^- + {}^{12}C \rightarrow n + 2{}^4He + {}^4H^*$ the mass of the hyperon is determined from the ranges of the particles to be 2333 ± 7 M_e. Examination of the parent star for associated production has not yielded a charged K-particle. D.J.Prowse

539.18

6203. PION PRODUCTION BY INELASTIC SCATTERING OF ELECTRONS IN HYDROGEN. W.K.H.Panofsky, W.M.Woodward and G.B.Yodh.
Phys. Rev., Vol. 102, No. 5, 1392-8 (June 1, 1956).

The ratios of the yield of electron-induced to photon-induced pion processes have been measured at an incident energy of 600 MeV. Measurements have been made at energies of 60 and 170 MeV for positive pions. The result is expressed in terms of "the equivalent radiation length" X_C defined so that the pion yield due to direct electron production is equal to the pion yield due to photons produced by electrons in a radiator of X_e radiation lengths. The results are X_e = 0.0191 ± 0.0011 for 60 MeV pions and X_e = 0.0178 ± 0.0023 for 170 MeV pions. At the lower pion energy the value is somewhat lower than the theoretical value if equal transverse and longitudinal interactions are assumed. If the contribution from the longitudinal matrix element is taken to be small or if the electron contribution from large angles of electron scattering is suppressed, then the value can be fitted. The value at 170 MeV is in agreement with predominantly magnetic-dipole absorption corresponding to the enhanced $P_{3/2,\,3/2}$ state of the final pion-nucleon system. A.

539.18 : 530.145

6204. MULTIPLE PRODUCTION OF MESONS IN COLLISIONS OF PARTICLES. L.G.Yakovlev.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 203-5 (1956). In Russian.

Perturbation calculations are carried out in standard field theory using PS mesons in PS and PV coupling. G.E.Brown

539.18

6205. REACTION $p + p \rightarrow \pi^0 + p + p$ IN THE REGION 400-600 MeV. L.M.Soroko.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 296-303 (1956). In Russian.

Analysis similar to Rosenfeld's (Abstr. 11451/1954) shows that the T = 3/2, J = 3/2 nucleon isobar cannot take an overwhelming part in this process, especially since the nucleon cannot come off in an S-state relative to the isobar, but must have an angular momentum of at least one. Hence, one might expect a monotonic rise with energy of the cross-section. In this experiment a liquid hydrogen target is bombarded by protons slowed down by polythene blocks. Gamma-rays from the decay of π^0-mesons are registered by a system of a telescope of three scintillation counters with a lead convertor before the second counter, and a Cherenkov counter. Measurements of the cross-section at 90° in the region of $1 < \eta < 1.9$, where $\eta = p_m/\mu c$ and p_m = maximum meson momentum, μ = mass, show a monotonic rise with η. Assuming an isotropic distribution so as to get a total cross-section, the results are fitted by $\sigma^{\pi^0}_{pp} = C\eta^{\alpha}$ where $\alpha \cong 4$. (This dependence is much weaker than that predicted by Rosenfeld). A rough evaluation of the absolute value at full energy gave the cross-section at 90° for γ-rays as $(4.5 \pm 1.8) \times 10^{-28}$ cm²/sterad. Several results from other work published only in internal reports are given in tables and figures of this article. G.E.Brown

539.185

6206. SCATTERING OF FAST NEUTRONS BY A PARTIALLY TRANSPARENT NON-SPHERICAL NUCLEUS. E.V.Inopin.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 210-12 (1956). In Russian.

General formulae are obtained in the adiabatic approxima tion and evaluated in the limits of small and large angles and high energy. G.E.Brow

STRUCTURE OF SOLIDS 539.2

539.213 : 535.34

6207. CONTRIBUTION TO THE KNOWLEDGE OF VITREOUS SILICA. V.Garino-Canina.
Cahiers de Phys., No. 66, 29-43 (Feb., 1956). In French.

The earlier parts of this investigation are reported in Abstr. 4680-1 (1956). Quartz has two maxima between 2 and 3.5 μ and a large absorption band beyond 3.5 μ. Silica formed by fusion of quartz with water present shows a strong absorption band at 2.72 μ, corresponding to a very loosely bonded OH group; this band is absent for quartz fused with no water present, and it does not disappear on heating or remelting in vacuo. This band is therefore due to a chemical reaction of silica and water on fusion. Interference techniques are used to investigate the inhomogeneities in vitreous silica, but no explanation can be given of the nature of these faults. 86 refs. C.Turner

539.215.08 : 535.826

THE PRODUCTION OF TRANSPARENT PROFILES OF DUST PARTICLES AS AN AID TO AUTOMATIZED PARTICLE COUNTING. See Abstr. 5041

539.216 : 536.413

STABILITY OF LAYER STRUCTURES IN IONIC AB COMPOUNDS. See Abstr. 5043

539.217

6208. DIFFUSION OF $^{22}Na^+$, $^{42}K^+$ AND $^{137}Cs^+$ IN SINGLE CRYSTALS OF KCl. H.J.Arnikar and M.Chemla.
C.R. Acad. Sci. (Paris), Vol. 242, No. 17, 2132-5 (April 23, 1956). In French.

Diffusion coefficients D were measured in the temperature range 570°C to 750°C (in the region of intrinsic ionic conductivity) by determining penetration curves with a conventional slicing technique. Plots of log D against the inverse of the absolute temperature (T) give approximately parallel straight lines corresponding to an approximate activation energy of 1.75 eV. The absolute magnitudes of D at given T are in the decreasing order Na^+, K^+, Cs^+. In addition, diffusion experiments in the presence of a steady electric field are described. These enable the electrical mobility V of the radioactive ions to be determined; in this way the Einstein relation (V/D = e/kT) has been verified. A.B.Lidiar

539.21

6209. INTERSTITIALCY DIFFUSION MECHANISM IN SILVER CHLORIDE. J.E.Hove.
Phys. Rev., Vol. 102, No. 3, 915-16 (May 1, 1956).

Reports lattice theoretical calculations of the activation energies (ΔU) for movement of the Ag^+ ions. In the assumed mechanism, an interstitial ion moves by pushing a normal ion into an interstitial position and itself occupying the normal site so vacated. Detailed computations for the case where the two ionic displacements are inclined at $\cos^{-1}(1/3)$ to each other lead to ΔU = 0.8 eV. When the ionic displacements are co-linear, ΔU is found to be close to zero. Further calculations indicate, however, that in equilibrium the two Ag^+ ions form a dumbell arrangement, about a normal lattice site, with [111] orientation. For the single dumbell separation discussed (1.92 A) the energy was 0.17 eV lower than that of the conventional configuration in which the interstitial ion is at the cube centre. (The observed ΔU for interstitial migration is about 0.15 eV, Abstr. 7512/1955). A.B.Lidiar

539.231

210. CONTROLLED SPUTTERING OF METALS BY LOW-NERGY Hg IONS. G.K.Wehner.
hys. Rev., Vol. 102, No. 3, 690-704 (May 1, 1956).

Sputtering has been studied under well controlled condi-ons i.e., low gas pressure (1 micron), defined energy (up to 00 eV) and angle of incidence of the bombarding ions, and gh ion-current density (10 mA/cm^2), by immersing the target a low-pressure Hg plasma of high density created in a pool-pe vacuum arc. It turned out that threshold energies (mini-um ion energy for sputtering to ensue) are considerably wer under oblique than under normal incidence, and the atoms re ejected away from the direction of incidence. Thresholds ere measured for twenty-three metals under normal incident g-ion bombardment. They follow, without exception a simple w: The product of the momentum transferred at threshold om ion to target surface atom and the sound velocity of the rget material is proportional to the heat of sublimation of the rget material. The threshold energies to be expected accord-gly in the case of rare gas ion bombardment under normal cidence are tabulated. The yield (atoms per ion) v. ion energy as carefully measured for the case of polycrystalline Pt. hen metal single crystals were sputtered, it was discovered at atoms are preferentially ejected in the directions of losest packing, that is [110] in fcc, [111] in bcc and diamond ttice. Deposits sputtered from plane low-index surfaces of ingle crystals therefore form characteristic patterns. Their tudy reveals more details: At low ion energy, only such atoms re sputtered as have no obstructing neighbours in the way of a lose-packed direction. At higher ion energy, additional atoms re set free from positions where neighbour atoms interfere. uch atoms deviate in a characteristic way from the directions f close packing. Most atoms sputtered in close-packed direc-ions which are parallel to the surface are trapped again, ausing growth of oriented hillocks. The possibility for crys-al growth by sputtering was demonstrated in another experi-nent. Some characteristic features of the etch effects caused y sputtering are described. The basic process in sputtering t low ion energies is one of momentum transfer. The impor-ant parameters with respect to the gas discharge are ion nergy, angle of incidence, and atomic weight of ion; on the arget side they are the atomic weight, the elastic constants, rystal structure and orientation, the heat of sublimation, dis-ocations, and surface roughness. Many details need further larification, and the studies are being continued. A.

539.231

211. THEORY OF THE SPUTTERING PROCESS. .E.Harrison, Jr.
hys. Rev., Vol. 102, No. 6, 1473-80 (June 15, 1956).

The mathematical methods of neutron diffusion theory are pplied to the problem of cathode sputtering. The state of all articles not in thermal equilibrium with the lattice can be des-ribed by a gas-like model in which the atoms move with con-tant mean free path. Collisions are assumed to occur only ith "fixed" lattice atoms, but binding energies are neglected. he distribution functions exhibit finite discontinuities in the nergy which approximate the behaviour of the correct func-ions. The sputtering ratio is determined by integration over he velocity direction and also over energy, thus averaging out he approximation. The resulting expression for the sputtering atio depends upon four atomic parameters of the system. In rinciple all are measurable, but only the mass ratio is known ith precision at the present time. The theoretical curve is itted to the experimental data which are available for eight on-metal combinations. The curve is found to be very sensi-ive to the choice of fitting parameters, and the parameters xhibit considerable internal consistency. The theory indicates ertain areas of experimental research which should add to resent understanding of the process. A.

539.232 : 531.717 : 537.224

6212. USE OF CAPACITY MEASUREMENTS FOR THE STUDY OF OXIDE FILMS ON METALS. J.N.Wanklyn.
Nature (London), Vol. 177, 849-50 (May 5, 1956).

Determinations of oxide film thicknesses from measurements of capacity in metal–electrolyte systems can be invalidated if the oxide layer is cracked, the capacity then being higher than for a uniform film. In this work, this effect is used to study the corrosion-resistant properties of oxide films on some zirconium alloys. Comparison is made between the film thickness as determined by the change in weight of a specimen, and the apparent thickness from capacity measurements. One alloy, Zircalloy 2, is found to form crack-free films, very resistant to corrosion. D.G.Avery

539.27

6213. SPECIMEN CONTAMINATION IN ELECTRON-MICROSCOPE. Y.Mizushima, S.Hirota and H.Noake.
J. Phys. Soc. Japan, Vol. 11, No. 4, 463-4 (April, 1956).

Electron micrographs of gold black particles on various substrate films show heavy growth of contamination on electron bombardment. The substrate and heat-treated blacks show little contamination. The special activity of the metal black may be the cause for this. A.E.I.Research Laboratory

539.27

6214. INVESTIGATION OF A Cu–MgO MIXTURE WITH THE HELP OF ELECTRON DIFFRACTION. S.Yamaguchi.
Z. Naturforsch., Vol. 11a, No. 3, 255-6 (1956). In German.

The electron diffraction lines arising from a mixture of Cu–MgO can be labelled as to their origin by examination with electrons of various energies. With increasing electron wavelength (from 0.03 to 0.05 A) the intensities of the Cu reflections fall off markedly, owing to the increase in absorption for Cu. J.Thewlis

539.27 : 536.48

6215. ELECTRON DIFFRACTION PICTURES OF THIN METALLIC LAYERS AT LOW TEMPERATURES. H.Bülow and W.Buckel.
Z. Phys., Vol. 145, No. 2, 141-50 (1956). In German.

Thin layers of Al, Zn, In, Tl, Pb and Mg were deposited on cold (down to 20° K) substrates and examined by electron diffraction. All the metals were crystalline but showed broad diffraction lines — the lower the temperature the broader the lines. The breadth is believed to be a function of crystallite size. No relationship between line breadth and superconductivity was found. J.Thewlis

539.27

6216. ON THE FAITHFULNESS OF REPRODUCTION IN LACQUER REPLICAS. H.Kimmel.
Z. angew Phys., Vol. 8, No. 5, 227-33 (1956). In German.

The faithfulness of reproduction in replication is studied with both multiple-beam interference and with an electron microscope. The effect of drying of the film is studied and it is shown that this leads to a simultaneous alteration both in film thickness and in the pattern which is replicated. If the film thickness is less than the differences in height in the object, then an amplitude develops on the surface of the free lacquer which operates in opposition to surface tension. This amplitude is studied as a function of the wavelength of the pattern, the thickness of the film and the properties of the lacquer. Both theoretical methods and experimental methods are applied to the examination of these properties. Not only are surface structures reduced, but in addition false structures can appear. The limits of accuracy in the correctness of replication are discussed. S.Tolansky

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.31

6217. STRESSES AND STRAINS IN A DISTURBED ELASTIC MEDIUM. G.Rieder.
Z. Naturforsch., Vol. 11a, No. 2, 171-3 (1956). In German.

Krŏner's treatment of thermal stresses (Abstr. 7429/1955) is used as a basis for deriving an expression for the total strain ϵ_t (the sum of Hooke's stress-induced strain ϵ_σ and externally impressed strain ϵ_λ (e.g. due to thermal stresses): $\epsilon_t = \epsilon_\lambda + s...\mathrm{Inc}\,\chi$, where $\epsilon_\sigma = s...\sigma_t$, and the operator $\mathrm{Inc}\,\chi \equiv \nabla \times \chi \times \nabla$. A corresponding expression for total stress $\sigma_t(= \sigma_\lambda + \sigma_\epsilon)$ can be used to separate magneto-elastic coupling from other types of stresses in the phenomenological theory of magnetostriction. A physical explanation of the energy terms W_{comp} and W_{inc} yielded by the stress theory and the strain theory approaches is given. The sum of these two energy terms, the "free deformation energy", is identical with the magnetostriction part of crystal energy. A.Gelbtuch

539.32

6218. DEPENDENCE OF THE ELASTIC PROPERTIES OF CADMIUM ON TEMPERATURE. S.V.Subrahmanyam.
Nature (London), Vol. 177, 852 (May 5, 1956).

The dependence at a frequency of 100 kc/s of 99% pure polycrystalline cadmium was studied. A change in the gradient of (frequency)^2 v. temperature occurs at 130° C due to stress relaxation at the grain boundaries. W.Bardsley

539.32

6219. TEMPERATURE VARIATION OF THE ELASTIC CONSTANTS OF AgBr. D.S.Tannhauser, L.J.Bruner and A.W.Lawson.
Phys. Rev., Vol. 102, No. 5, 1276-81 (June 1, 1956).

By use of an ultrasonic pulse technique the elastic constants of AgBr have been measured between room temperature and the melting point. Resonance techniques have also been used to measure S_{11} in the same temperature range. The results of the two different methods are the same within the limits or error. It is found that C_{44} decreases only slightly with increasing temperature; C_{11} and C_{12}, however, show a marked decrease, being reduced from their room temperature values by more than a factor of two at 400° C. The effect of lattice imperfections on the elastic constants is discussed. A.

539.32

6220. ELASTIC MODULI OF INDIUM ANTIMONIDE. R.F Potter.
Phys. Rev., Vol. 103, No. 1, 47-50 (July 1, 1956).

By using the composite resonator technique, the elastic moduli of InSb have been measured as a function of temperature between 77° K and 700° K. The results give good agreement with Born–Smith dynamic lattice theory if nearest neighbour interactions alone are considered. The value of θ_D is found to be 208° K by using Sutton's method. High-temperature behaviour of the constants is discussed. A.

539.32 : 534.2

A METHOD OF MEASURING THE MECHANICAL PARAMETERS OF RUBBER AT SONIC AND ULTRASONIC FREQUENCIES. See Abstr. 4901

539.32 : 537.228.2

THE TEMPERATURE OF THE ELASTIC PROPERTIES OF BARIUM TITANATE CERAMIC. See Abstr. 5081

539.3

6221. ELASTIC, PLASTIC PROCESSES IN THE BRINELL BALL INDENTATION TEST. W.Prigge.
Z. angew. Phys., Vol. 8, No. 4, 183-6 (1956). In German.

For a steel (St 70), brass (Ms 58), and duralumin (Al Cu Mg), relationships are found between the applied load and (radius of curvature of impression)/(radius of steel ball) and also (depth of impression)/(radius of ball). A relationship is then found to exist between these two ratios and this is used to compute the elastic portions of the indentation processes. It was found difficult to compute the plastic portion and a photoelastic technique was used in which a cylinder lying on its side was pressed into the material by varying amounts. A.C.Whiffin

539.37

6222. THE INFLUENCE OF SECONDARY SLIP SYSTEMS ON THE WORK-HARDENING OF FACE-CENTRED-CUBIC SINGLE CRYSTALS. J.Diehl and H.Rebstock.
Z. Naturforsch., Vol. 11a, No. 2, 169-71 (1956). In German.

From the results of experiments with combined tensile and torsional stresses on single-crystal copper tubes, it is concluded that the increased work-hardening in the region II of the stress–glide curve is due to the effects of secondary slip in shortening the paths of dislocations. Observations of slip lines on the surface of the crystal confirm this conclusion A.E.De Barr

539.4.016.2 : 538.22

MAGNETIC ANISOTROPY AND COLD WORKED TEXTURE OF TITANIUM. See Abstr. 5231

539.4

6223. DYNAMIC BURSTING TESTS ON HOLLOW SPECIMENS. H.Voigt.
Z. angew. Phys., Vol. 8, No. 4, 155-8 (1956). In German.

An account is given of experiments done elsewhere to determine the tensile strength of materials at high rates of loading. Details are given of test equipment for dynamic tests on hollow specimens, cylindrical in form and closed at one end. The specimen is filled with water or oil and the internal pressure is raised at the required rate by inserting a piston into an associated cylinder. Oscillograms are given showing the change of pressure with time. The equipment is used to test polyamide materials and the results of dynamic tests are compared with those of normal low-speed testing. A.C.Whiffin

539.62

6224. THE MEASUREMENT OF FRICTIONAL FORCES AT VIBRATING CONTACTS. J.S.Halliday.
J. sci. Instrum., Vol. 33, No. 6, 213-17 (June, 1956).

A simple machine is described which is used for the investigation of wear phenomena at vibrating contacts. It is shown theoretically how the frictional forces at the contacts can be measured and the experimental tests substantiate the theory. Some friction measurements are given which were obtained using brass specimens immersed under silicone oils having a wide range of viscosities. It was found that the friction was least for the medium viscosity oils. The higher friction with the high viscosity oils arose because these oils were pushed aside from the contacts, and with the lowest viscosity oils because they were not as effective in preventing the growth of intermetallic welds as the medium viscosity oils. A

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.124

6225. APPLICATION OF THE VAN'T HOFF REACTION ISOBARS TO MOLECULAR COMPOUNDS. H.Mauser.
Z. Naturforsch., Vol. 11a, No. 2, 123-7 (1956). In German.

A critical investigation into the possibility of applying the van't Hoff reaction isobar to determine the reaction enthalpy of molecular compounds. A relationship is established, enabling the order of magnitude to be estimated of the error involved in the use of the van't Hoff isobar in the infinite concentration range. An appendix contains a survey of the possibilities of standardization based on infinitely diluted solutions by measuring concentration in terms of kg or volume molality.
F.Lachman

541.127.4 : 530.15

ON THE DESCRIPTION OF RATE PROCESSES BY MEANS OF RELAXATION TIMES. See Abstr. 4848

ELECTROCHEMISTRY 541.13

541.136

6226. ESSENTIAL SCIENTIFIC PROBLEMS ASSOCIATED WITH ELECTROCHEMICAL CELLS BASED ON MANGANESE DIOXIDE. J.Brenet.
Rev. gén. Élect., Vol. 65, No. 1, 61-4 (Jan., 1956). In French.

The problems which arise in Leclanché cells, containing a zinc anode and a cathode composed of a mixture of manganese dioxide and carbon, are discussed in the order of anode, cathode, nature and composition of the manganese dioxide employed, and the mechanism of depolarization. It is concluded that no theory can as yet completely interpret the mechanism of these cells. 48 refs.
H.H.Hodgson

541.138

6227. APPLICATION OF THE VAN'T HOFF REACTION ISOBAR TO REVERSIBLE GALVANIC ELEMENTS.
H.Mauser and G.Kortüm.
Z. Naturforsch., Vol. 11a, No. 3, 196-200 (1956). In German.

The feasibility is investigated of using van't Hoff reaction isobars for determining the reaction enthalpy from the temperature-dependence of the e.m.f. of reversible galvanic elements. A simple (uncritical) application of these isobars is inadmissible if the mixed phase in which the reaction takes place is in thermal equilibrium with other phases. Correct relationships are derived for the following cases: (1) all reaction participants are in equilibrium with their real phases, (2) one participant is present in the form of unsaturated solution, and (3) one participant is present in saturated form as solvate.
F.Lachman

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14 : 541.15

6228. FORMATION OF FREE RADICALS IN THE PROCESSES OF PHOTOPOLYMERIZATION AND RADIATION POLYMERIZATION. S.S.Medvedev.
J. Chim. phys., Vol. 52, No. 9, 677-88 (Sept., 1955). In French.

A comparison of the photochemical and the radiation chemical initiation of polymerization leads to a kinetic interpretation which involves the participation of solvent molecules. Intermolecular energy conductance can be shown to occur in systems containing two or more solvents. Experimental work published in Russia on a number of monomer solutions is reported.
M.Ebert

541.15

6229. EFFECT OF IONIZING RADIATIONS ON CATALASE.
P.Bonet-Maury and F.Patti.
J. Chim. phys., Vol. 52, No. 9, 617-20 (Sept., 1955). In French.

The radiosensitivity of catalase, as measured by the loss of enzyme activity, is found to be different for preparations from different sources. It decreases if the preparations are purified by electrophoresis before irradiation. All preparations showed a post-irradiation effect, but the radiation reaction was not influenced by dissolved oxygen. The conclusion is drawn that the free radical OH is responsible for the inactivation of the enzyme.
M.Ebert

541.15

6230. ACTION OF IONIZING RADIATIONS ON CATALASE IN THE PRESENCE OF CYSTEINE, CYSTINE AND GLUTATHIONE. W.M.Dale and C.Russell.
J. Chim. phys., Vol. 52, No. 9, 621-5 (Sept., 1955). In French.

If subjected to electrophoresis, catalase moves towards the positive electrode. Irradiated catalase gives a streak, the boundary of which moves at the same rate as the unirradiated catalase. The same result was obtained whether cysteine, cystine, glutathione or oxygen were present or absent during the irradiation. The ratio of the optical densities at 275 mμ and 405 mμ of irradiated solutions of catalase were characteristic for the conditions of the experiment. It was also observed that the above-mentioned substances had an effect on the activity of the catalase even without irradiation. This fact might mask the effect of low radiation doses on catalase. It is concluded that catalase is inactivated by oxidizing radicals.
M.Ebert

541.15

6231. CHEMICAL SYNTHESIS FOLLOWING THE ACTION OF IONIZING RADIATIONS. J.Loiseleur.
J. Chim. phys., Vol. 52, No. 9, 626-33 (Sept., 1955). In French.

The synthesis of such dyes as fuchsine, malachite green, Lauth's violet, acridine, methylene blue or aniline black, which require the addition of an oxidizing agent to the mixture of reactants, can be carried out by using ionizing radiation to produce peroxides in the reaction mixture. The synthesis often occurs as a post-irradiation effect and can be speeded up by warming of the mixtures. If a mixture of methyl chloride, ammonium hydroxide and m-phenyl diamine in methyl alcohol is irradiated, xanthyl urea can be extracted from the mixture. The yield of the urea derivative reaches a maximum after 1.5×10^6 r. The concentrations of the reactants in the irradiated mixture critically determines the yield.
M.Ebert

541.15

6232. REDUCTIONS IN AQUEOUS SOLUTIONS INDUCED BY IONIZING RADIATION. G.Stein.
J. Chim. phys., Vol. 52, No. 9, 634-44 (Sept., 1955). In French.

The reduction of methylene blue, cytochrome C and coenzyme I are discussed to show the specificity of different radicals. Different reaction mechanisms for radiation effects on DPN and N-alkyl nicotinamide are suggested, in analogy to enzymic reactions and to reductions carried out with hydrosulphites and hydroborate.
M.Ebert

541.15

6233. THE EFFECT OF RADIATIONS ON THE CHLORINATION REACTION OF AROMATIC HYDROCARBONS.
D.E.Harmer, J.J.Martin and L.C.Anderson.
J. Chim. phys., Vol. 52, No. 9, 667-76 (Sept., 1955). In French.

When Co^{60} γ-radiation from a 60, 3.0 and 0.3 kc source was used to irradiate benzene derivatives, the reaction with chlorine was so violent that very efficient cooling and dilution with CCl_4 had to be applied. In the case of toluene, one chlorine atom is added in the aromatic ring, before substitution of the side-chain and saturation of the aromatic structure occur. The rate of the substitution reactions depended on the square root of the radiation intensity between 7.9 and 28.4 x 10^3 rep/hr, and on the square root of the chlorine concentration, whereas that of the addition reactions depended on the square of the chlorine concentration. The following values were found: G = 85 000 for benzene; G = 17 000 for toluene; and G = 43 000 for chlorbenzene chlorination. M.Ebert

541.15

6234. RADIATION CHEMICAL POLYMERIZATION OF VINYL MONOMERS. A.Chapiro, M.Magat, A.Prévot-Bernas and J.Sebban.
J. Chim. phys., Vol. 52, No. 9, 689-98 (Sept., 1955). In French.

Some new experiments and a critical review of published work leads to the conclusions that polymerization is initiated exclusively by free radicals, that the solvent or the mixture of solvents are the main sources of the primary free radicals, that no experimental facts contradict the assumption of homogeneously distributed free radicals at the initial stages of polymerization and that the observed kinetic anomalies are linked to the latest stages of the polymerization reactions when the newly formed polymer, if not removed, may interfere by cross-linking or by forming excessively long chains. M.Ebert

541.15

6235. X-RAY INDUCED CROSS-LINKING OF POLYMERS IN AQUEOUS SOLUTIONS. A.Charlesby and P.Alexander.
J. Chim. phys., Vol. 52, No. 9, 699-709 (Sept., 1955). In French.

Polyvinyl pyrrolidine is representative for a number of polymers, which undergo cross-linking if irradiated in aqueous solutions at concentrations higher than 0.5%. A detailed discussion of the end-linking process is given, which agrees with the experimental findings. Thiourea protects the polymer from the effect of radiation by competing for free radicals formed in the water. Some possible biological implications are discussed. M.Ebert

541.15

6236. AFTER-EFFECTS OF THE X-RAY INDUCED POLYMERIZATION REACTIONS OF METHACRYLIC ACID IN AQUEOUS SOLUTION. M.Fox and P.Alexander.
J. Chim. phys., Vol. 52, No. 9, 710-17 (Sept., 1955). In French.

The rate of polymerization in oxygen-free aqueous solutions shows a maximum for 7.5% and a minimum for 65% monomer concentration. For higher concentration the reaction becomes very complex. The direct effect is supposed to be responsible for the decreasing rate between 7.5% and 65%. The after-effect, a reaction occurring after the end of the exposure, proceeds at a rate roughly proportional to the monomer concentration. The precipitated polymer could induce polymerization in fresh monomer solutions even after it had been exposed to air for long periods. M.Ebert

541.15

6237. OBSERVATIONS ON SZILARD AND CHALMERS EFFECT IN CHROMIC ACID AND CHROMIUM SULPHATE.
N.Ivanoff and M.Haissinsky.
J. Chim. phys., Vol. 53, No. 4, 400-1 (April, 1956). In French.

The retention of chromium vi in the Szilard–Chalmers effect is increased with the pH and decreases with an excess of anions in the solutions. Irradiations were made in a neutron flux of the order of 10^{10} n/cm². sec from the Chatillon reactor and the technique of separating the two valency states of the radio-chromium is detailed. A mechanism is proposed to explain these observations following upon the work of Fishman and Harbottle (Abstr. 9715/1954). Finally, the yield of the effect reaches 20% when pure water suspensions of Cr $(OH)_3$ are irradiated. T.A.Chalmers

541.15

6238. ON THE ACTION OF ELECTRON BEAMS AND OF X-RAYS OF MEDIUM ENERGY ON POLYETHYLENE.
H.Luy and K.Schumacher.
Z. angew. Phys., Vol. 8, No. 5, 222-6 (1956). In German.

The dependence of expansion v. temperature curves, of infrared spectrograms and of electrical properties on radiation dose both in the absence of O_2 and in the presence of air is investigated. The apparatus is described. Irradiation of the polyethylene foils in air is found to bring about oxidation. W.Good

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.182.022

6239. THE STATISTICS OF AN ADSORBED MONOLAYER WITH REPULSIVE INTERACTION BETWEEN THE ADSORBED PARTICLES. P.W.Kasteleijn.
Physica, Vol. 22, No. 5, 397-407 (May, 1956).

The properties of a monolayer of particles adsorbed on a surface with a two-sublattice structure, within which there is a positive interaction energy (repulsive force) between neighbouring particles, are investigated by means of a method developed for ferro- and antiferromagnetism (Abstr. 6001/1956). The grand partition function of the monolayer is expressed in terms of the effective energy V_e of a pair of neighbouring lattice sites, which is of a very simple form. By making an assumption about V_e analogous to the assumption of constant effective coupling in an Ising spin system the constant coupling approximation is obtained, which is equivalent to the quasi-chemical, or Bethe–Peierls approximation. On the basis of this approximation it is shown that for temperatures lower than a certain critical temperature the monolayer can exist in two phases, namely a disordered phase in which the two sublattices are equally covered by adsorbed particles, and an ordered phase in which there are more particles in one sublattice than in the other. The latter phase is realized only if the pressure p of the gas with which the monolayer is in equilibrium lies between two limits, p_- and p_+, which depend on the temperature. For $p \leq p_-$ and for $p \geq p_+$ the system is in the disordered phase, and both at $p = p_-$ and at $p = p_+$ a phase transition occurs. The energy E and the fraction Θ of the lattice covered with atoms are continuous in these two transition points, but there is a jump in the derivatives $\partial E/\partial\Theta$ and $\partial\Theta/\partial p$. The adsorption isotherms are studied in detail, and the heat of adsorption is calculated as a function of Θ. A.

541.183

6240. ON GAS ADSORPTION AT HIGH PRESSURES.
W.Kübler.
Dissert. E.T.H. Zurich, No. 2426, 79 pp. (1955). In German.

A review of theories of adsorption is given, with particular reference to specific surface, pore size distribution, pore volume and various measures of density; the experimental determination of these quantities is also discussed. An apparatus is described for the determination of adsorption isotherms at pressures up to ~ 300 atm., and the results, for N_2 on charcoal and silica gel at temperatures −78°C to 0°C, show a maximum in the adsorption isotherm at a pressure usually

! the order 50-100 atm. It is concluded that at high pressures ıe adsorbed layer is multimolecular even at temperatures ɔove the critical. S.J.Gregg

CHEMICAL STRUCTURE 541.2/.6

541.64

!41. KINETICS OF CAPILLARY SHEAR DEGRADATION N CONCENTRATED POLYMER SOLUTIONS. A.B.Bestul. . chem. Phys., Vol. 24, No. 6, 1196-201 (June, 1956).

Intrinsic viscosities at successive stages of the process ave been used to obtain the rates of mechanical shear degraation produced in concentrated solutions of polyisobutenes in etane by capillary flow at several high rates of shear. Rates f degradation were obtained for several shearing temperaıres, polymer concentrations, and initial molecular weights. ıte constants K are calculated on the basis that the process s a first-order reaction with respect to the polymer molecular onds. K is treated as an inverse exponential function of the eciprocal of the rate of shear energy application J. Plots of ogK v. 1/J for all shearing temperatures and polymer concenrations reported can be represented by a single straight line. he behaviour of these plots with changing temperature suports the idea that the degradation process is a predominantly echanically, rather than thermally, activated reaction. Their sensitivity to polymer concentration supports the assumpon that the degradation reaction is of first order. The rate f variation of K with J decreases with increasing initial moleılar weight. This fact indicates that as the initial molecular eight increases the polymer molecular entanglements become ıcreasingly effective in localizing mechanically applied shearg energy into the polymer molecular bonds as temporarily tored potential energy, as would be expected. A.

541.64

242. "DONOR-ACCEPTOR" COMPLEX FORMATION BY IGH POLYMERS. D.F.Evans. . chem. Phys., Vol. 24, No. 6, 1244-6 (June, 1956).

The interaction of iodine with polystyrene and rubber has been studied spectrophotometrically. Characteristic "charge-transfer" bands were observed, and interpreted quantitatively in terms of complex formation. The equilibrium constants and "molar" extinction coefficients of the polymer-iodine complexes are similar to those for the iodine complexes of analogous simple aromatic and olefinic molecules. Approximately half of the iodine in solid solution in polystyrene seems to be involved in complex formation. Polystyrene is soluble in strong alcoholic solutions of silver perchlorate, and the absorption spectrum of the solution indicates complex formation. A.

CHEMICAL ANALYSIS 543/545

545.827

6243. DETERMINATION OF RADIO-CESIUM IN FISSION-PRODUCT MIXTURES. R.B.Hahn and R.O.Backer. Nucleonics, Vol. 14, No. 5, 90, 92-5 (May, 1956).

Since other alkali metals do not occur to any extent as fission products, Cs may be separated by methods normally used for K. Full details are given of a method using dipicrylamine as a precipitating agent. R.D.Smith

545.844

6244. CHROMATOGRAPHIC INVESTIGATION OF BONDING IN PAPERING. H.Klingelhöffer. Z. angew. Phys., Vol. 8, No. 4, 171-5 (1956). In German.

The rate of absorption of glue components by, and resolution from, paper fibres determines the results of paper bonding. The reason for the increase of viscosity in the bonding gap and thus the development of adhesive force, is removal of solvent or dispersing medium. Such processes occur in paper chromatography, so that chromatographic model experiments can be a help in clearing up problems of bonding. The value of such an approach is shown by experiments on the distribution of glue components, penetration of solvent fronts into the layer of paper to be bonded, retention of glue after reaching the opposite surface, etc. Some special possibilities of this method of investigation, which uses only small specimens, are described. R.C.Murray

CRYSTALLOGRAPHY 548

548.33

245. THE POLYMORPHISM OF POTASSIUM DICHROMATE CRYSTALS. J.Jaffray and A.Labary. C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1421-2 (March 12, 956). In French.

Three crystal forms A, B and C have been found: A, table at room temperature changes into C at 269° C, with a olume increase of 5%. On cooling a transition of C to B ccurs at 240° C, and subsequent heating gives a transition B to C at 255° C with a small volume decrease. Melting and ecrystallization produces A, and a transformation of B to A can be produced at room temperature by applying a large ressure. C.Turner

548.5

6246. ON THE FORMATION OF NEEDLE-LIKE POTASSIUM CRYSTALS. W.Friemel and I.N.Stranski. Naturwissenschaften, Vol. 43, No. 4, 79 (1956). In German.

Gives an explanation of the formation observed by Neumann and co-workers (Naturwissenschaften, Vol. 42, No. 18, 510/1955) in the condensation of K from the vapour and states the formation occurs only when the glass tubes with sealed-in Ag wires used in the process are cleaned with chromosulphuric acid. The direction of growth of the needle can change abruptly and various possibilities are briefly considered. S.Weintroub

548.52

6247. ON THE THEORY OF CRYSTAL GROWTH (BASED ON THE ARTICLE BY I.V. SALLI). A.V.Belyustin. Zh. éksper. teor. Fiz., Vol. 28, No. 6, 725-6 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 535-6 (Nov., 1955).

A criticism of Salli's paper (Abstr. 8045/1953). It is shown that the fundamental equation derived by Salli, while being valid for isotropic liquids, cannot be applied to the analysis of crystal growth without investigating the feasibility of such an application. Several formal and more serious slips of Salli's are quoted. F.Lachman

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7.

6248. CALCULATION OF THE VIBRATION AMPLITUDE OF ATOMS OF A PERFECT CRYSTAL AS FUNCTION OF

TEMPERATURE. J.Peretti.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1852-5 (April 9, 1956). In French.

The distribution function of q_r, the displacement component of an atom from its equilibrium position, is a Gaussian one. When the number N of crystal atoms tends to infinity, q_r^2 tends to infinity in the same way as N for a unidimensional lattice, and as lnN for a bidimensional lattice, for any temperature. The expression for a terdimensional lattice contains the T parameter. F.Lachman

548.7 : 539.185.9

6249. IRRADIATION-INDUCED PHASE TRANSFORMATION IN ZIRCONIA. M.C.Wittles and F.A.Sherrill.
J. appl. Phys., Vol. 27, No. 6, 643-4 (June, 1956).

As a result of fast neutron bombardment, monoclinic ZrO_2 is transformed into the cubic phase normally stable only above 1900°C. It is suggested that the unique temperature-structure behaviour in the zirconia system lends itself to this transition in a manner whereby two possible mechanisms may be operative. Stresses acting about trapped interstitial atoms and thermal spike effects are presented as the possible mechanisms. A.

548.7

6250. EFFECT OF X-IRRADIATION ON SURFACE STRUCTURE OF SODIUM CHLORIDE CRYSTALS. H.R.Leider.
Phys. Rev., Vol. 101, No. 1, 56-8 (Jan. 1, 1956).

Electron diffraction studies of X-irradiated sodium chloride crystals have shown that after sufficient irradiation the surfaces of these crystals break up into small crystallites which exhibit preferred orientations. The time required to produce surface damage is much greater for water-polished crystals than for untreated ones. A.

548.7

6251. EXPANSION OF POTASSIUM AND SODIUM CHLORIDE CRYSTALS DUE TO X-RAY IRRADIATION OF WEAK INTENSITIES. L.-Y.Lin.
Phys. Rev., Vol. 102, No. 4, 968-74 (May 15, 1956).

Rectangular cleaved samples of potassium and sodium chloride crystals having dimensions of about 12 x 10 x 1.5 mm were irradiated for times up to three hours with X-rays (48 kV at 18 mA) from a molybdenum target tube passing through a beryllium window at room temperature in air and in helium atmospheres. The crystals were placed in a thermostatted enclosure regulated to within 0.01°C. The crystals were about $2\frac{1}{4}$ in. from the X-ray tube beryllium window. The change in length of the largest dimension of the crystal was measured during and after the irradiation by a capacitance-type dilatometer with a sensitivity of 10^{-8} cm. A series of measurements were carried out employing different times of irradiation and it was found that the relation between the relative linear expansion of the crystal and the optically determined average concentration of F-centres was linear with a constant of proportionality remarkably close to the value of $d^3/12$, where d is the lattice constant of the crystal. There was a time delay of about 20-30 minutes before the expansion could be detected. This time delay was increased by plastic deformation. The results did not depend on the fraction of the crystal volume which was irradiated. The rate of formation of a certain F-centre concentration in the irradiated portion of the crystal was directly proportional to the fraction of the volume exposed to the irradiation. In partially irradiated crystals, the rate of formation of F-centres in the nonirradiated portion upon subsequent irradiation was greatly increased by the presence of the adjacent irradiated part. The merits of possible models to explain these results are discussed. A.

548.7

6252. ASSOCIATION ENERGY OF VACANCIES AND IMPURITIES WITH EDGE DISLOCATIONS IN NaCl. F.Bassani and R.Thomson.
Phys. Rev., Vol. 102, No. 5, 1264-75 (June 1, 1956).

Calculations have been made of the energies of association of Sr^{++} ions, Cd^{++} ions, and positive-ion vacancies with the core of a (110) edge dislocation in NaCl. It is found that the vacancy has an association energy of 0.4 eV, but that other impurities have smaller association energies. On the basis of this energy of association, the numbers of vacancies and divalent ion-vacancy complexes pinned in the cores of the (110) edge dislocations in a well-annealed crystal were calculated. These numbers are large enough at room temperature to suggest that impurity and vacancy pinning might be the agent determining the critical yield stress in annealed NaCl. The elastic field interaction between point defects and a dislocation is tabulated and compared with the interaction obtained within the core. It is shown that the elastic energy of interaction does not necessarily project into the core in a smooth fashion, but that in the case of the vacancy, an elastically "large" inclusion behaves like a "small" inclusion in the core. Several possible suggestions are made which may explain the strong hardening effect of divalent impurity additions to NaCl. A.

548.7 : 539.219

6253. MOVING DISLOCATIONS AND SOLUTE ATOMS. G.Schoeck.
Phys. Rev., Vol. 102, No. 6, 1458-9 (June 15, 1956).

In the stress field of a moving dislocation, stress-induced local rearrangement of solute atoms takes place. From this rearrangement there results a friction force, which depends on the velocity of the dislocation. It should be possible to detect this effect in creep experiments. A.

548.7 : 536.413

6254. MACROSCOPIC EXPANSION AND DEFECTS OF SILVER BROMIDE. W.Zieten.
Z. Phys., Vol. 145, No. 1, 125-40 (1956). In German.

Macroscopic measurements of the thermal expansion of AgBr, and AgBr with $CdBr_2$ impurity, are made from which the production of lattice defects can be studied. Below 250°C only one kind of defect occurs (Schottky) but at higher temperatures two types are present (Schottky plus Frenkel defects). G.F.J.Garlick

548.7

6255 INTENSITIES OF THE R_1 AND R_2 BANDS IN KCl CRYSTALS. R.Herman, M.C.Wallis and R.F.Wallis.
Phys. Rev., Vol. 103, No. 1, 87-93 (July 1, 1956).

Measurements have been made of the intensities of the R_1, R_2, M and N bands in KCl crystals as functions of F light irradiation time. Both X-rayed and additively coloured crystals were used. The X-raying and F light irradiation were done at room temperature. The optical absorption measurements were made at liquid nitrogen temperature to improve the resolution of the bands. In both the X-rayed and additively coloured samples the ratio of the R_2 and R_1 band intensities varied by less than a factor 1.5 when the individual intensities varied by a factor 6 or greater. No other pair of bands studied showed such a small variation in their intensity ratio. Theoretical frequencies and oscillator strengths were obtained for the $1s\,\sigma - 2p\,\sigma$ and $1s\,\sigma - 2p\,\pi$ transitions of H_2^+ immersed in a dielectric medium and for the $1s - 2p$ transition of the hydrogen atom immersed in a dielectric medium. Frequencies were also obtained for the $^1\Sigma_g^+ - {}^1\Pi_u$ and $^1\Sigma_g^+ - {}^1\Sigma_u^+$ transitions of H_2 immersed in a dielectric medium. For KCl the computed frequencies of the last three transitions named have approximately the same magnitude and fall in the same order as the observed F, R_1 and R_2 bands, respectively. It appears possible that the observed R_1 and R_2 bands may arise from two transitions of the system of two electrons trapped at a pair of adjacent negative ion vacancies. A.

548.7

6256. ON THE DISTRIBUTION OF COLOUR CENTRES AND OTHER DEFECTS IN NATURAL ROCK SALT CRYSTALS. K.Przibram.

S.B.Osterr. Akad. Wiss. IIa, Vol. 163, No. 8-10, 329-36 (1954). In German.

548.7 : 535.43

THE SCATTERING OF LIGHT BY SINGLE CRYSTALS. See Abstr. 5031

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.733

6257. X-RAY DIFFRACTION CAMERA FOR THE STUDY OF MOLTEN SALTS AT HIGH TEMPERATURES. J.Zarzycki.
J. Phys. Radium, Vol. 17, No. 3, 44 A - 51 A (March Suppl., 1956). In French.

See Abstr. 1744 (1956). The construction of a high-temperature camera is described. Difficulties caused by stray scattering and fluorescence radiation are considered. Scattering curves obtained from liquid GeO_2 at 1150° C and from a glass at 1400° C are reproduced. A. R. Stokes

548.733 : 537.542

A PROPORTIONAL COUNTER TUBE FOR X-RAY DIFFRACTIONAL ANALYSIS. See Abstr.5167

548.735

6258. PRECISION DETERMINATION OF LATTICE CONSTANTS. H.Weyerer.
Z.angew. Phys., Vol. 8, No. 4, 202-5 (1956). In German.

Describes a measurement of the lattice parameter of 99.998% pure gold. The value given is 4.070 106 ± 0.000 009 kX at 25.00 ± 0.02° C. (not corrected for refraction). A.R.Stokes

548.74

6259. AN ELECTRONOGRAPHIC DETERMINATION OF THE STRUCTURE OF $Tl_2Sb_2Se_4$. Z.G.Pinsker, S.A.Semiletov and E.N.Belova.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 6, 1003-6 (1956). In Russian.

Material was sublimed from a 50 : 50 alloy of Tl_2Se and Sb_2Se_3 on to a cellulose film. Oblique electronograms gave 80 independent reflections from the textured polycrystalline structure and reflection electronograms were also obtained. From the unit cell volume and from a powder photograph the material was identified as $Tl_2Sb_2Se_4$. The structure is orthorhombic with a = 4.18, b = 4.50 and c = 12.00 A. Z = 1 and the space group is Pmna although approximating to Bmmm. The atomic coordinates are Sb, (0, 0, 0),positions (a); Tl, $(\frac{1}{2}, \frac{1}{2}, 0)$, positions (c); and Se, (0, 0.500, 0.272), positions (h). This structure, having layers of Tl and Sb atoms separated by chains of Se atoms, explains the flakiness of the crystallites.
A.L.Mackay

GEOPHYSICS 55

550.345 : 532.593

SURFACE WAVES IN THE OCEAN EXCITED BY UNDERWATER EARTHQUAKES. See Abstr. 4865

550.37

6260. SPONTANEOUS GENERATION OF NEGATIVE CHARGE BENEATH A COLUMN OF WATER. A.B.Arlick.
Sci. and Culture, Vol. 21, No. 8. 444-7 (Feb., 1956).

The question is raised whether the negative charge of the earth and the lower negative charge in a thundercloud may be due to a common physical source. A water column is set up in a nearly vertical position and attempts are made at measuring potential differences developing across a bottom section of the column. Whilst no potential difference was noted throughout lengthy periods of observation, a spontaneous e.m.f. was generated on two occasions, lasting about 2 days, when the column was positioned at an angle of 9° to the vertical in a definite geographical direction. No physical explanation is offered. R.H.Golde

550.384 : 551.594.221

MAGNETIC FIELD VARIATIONS FROM LIGHTNING STROKES IN VICINITY OF THUNDERSTORMS. See Abstr. 5566

550.93

6261. AGE DETERMINATION OF STONE METEORITES BY THE RUBIDIUM–STRONTIUM METHOD. E.Schumacher.
Z. Naturforsch., Vol. 11a, No. 3, 206-12 (1956). In German.

By a comparison of the present measurements on two types of meteor with others made by different methods, an age value of $4.7 \pm 0.4 \times 10^9$ years was obtained, and a value of 6.75 ± 0.03% for the "primordial abundance" of Sr^{87}. J.M.Hough

ATMOSPHERE. METEOROLOGY 551.5

551.508.79 : 537.312

6262. RESISTANCE VARIABLE WITH HUMIDITY. J.Coulon and G.Gayrard.
C. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2120-2 (April 23, 1956). In French.

The preparation is described of specimens of clay slate (l'ardoise) whose electrical resistance varies with their degree of humidity. A method (with apparatus) is then outlined for measuring the humidity of the atmosphere to which such detection specimens are exposed. Organic impurities are found to modify the electrical properties of the clay slates.
H.H.Hodgson

551.510.41

6263. RELATION BETWEEN THE REDUCED THICKNESS OF THE ATMOSPHERIC OZONE AND ITS CONCENTRATION AT GROUND LEVEL. I.Rasool.
C. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2168-71 (April 23, 1956). In French.

Daily values of the ozone content at ground level show no correlation with daily values of total ozone. A negative correlation between ozone content at ground level and number of inversions has been found. The seasonal variations are similar except that at ground level there is an extra maximum in June when the air at Val-Joyeux comes from the region of Paris. J.M.Hough

551.510.534

6264. ON THE INFRARED ABSORPTION OF OZONE. H.K.Paetzold.
Z. Naturforsch., Vol. 11a, No. 2, 128-30 (1956). In German.

Laboratory measurements of the relation between pressure and absorption for the 9.6 μ O_3 band are compared with the absorption of atmospheric O_3 when the height distribution is known from balloon measurements. It is shown that the 9.6 μ absorption can be expressed in terms of a "mean pressure". If the total atmospheric O_3 is measured by ultraviolet absorption, an indication of the height distribution can be obtained from the infrared absorption. G.F.Lothian

551.510.535 : 621.396.812

6265. SYSTEMATIC INVESTIGATIONS INTO THE INFLUENCE OF THE GEOMAGNETIC ACTIVITY ON THE NIGHT-TIME CRITICAL FREQUENCIES OF THE F_2 LAYER. G.Lange-Hesse.
Arch. elekt. Übertragung, Vol. 10, No. 4, 139-44 (April, 1956). In German.

The observational data of the Lindau/Harz ionospheric research station and the Wingst geomagnetic observatory are systematically analysed in order to find the detailed statistical relationships between the degree of geomagnetic activity and the deviations of the night-time critical frequencies of the F_2 layer from their median values. The observational data are arranged only according to the degree of geomagnetic activity; then both the simultaneous and the following average behaviour of the ionosphere is determined for the different degrees of geomagnetic activity. In the statistical relationship there exists a distinct dependence on the sunspot cycle and the seasons. The practical significance of these results is discussed in detail with respect to the prediction of night-time disturbances in short-wave radio communication. Figures are given representing the reliability of such predictions of disturbances for different seasons and phases of sunspot cycle. A.

551.510.535

6266. LUNAR TIDE IN SPORADIC E AT BRISBANE. J.A.Thomas and A.C.Svenson.
Austral. J. Phys., Vol. 8, No. 4, 554-6 (Dec., 1955).

Measurements of h'Es to an accuracy of $\pm$ 0.2 km on 2.28 Mc/s have been made at Brisbane at intervals of 6 min. throughout each night of a year. A 12 hr. harmonic dial is given which shows the existence of a significant lunar semi-diurnal tide of mean amplitude 0.69 km and phase 6.7 hr. G.M.Brown

551.510.535

6267. IONOSPHERIC OBSERVATIONS DURING THE SOLAR ECLIPSE OF JUNE 20, 1955. A.K.Saha, S.Ray, S.Datta and R.K.Mitra.
Sci. and Culture, Vol. 21, No. 8, 475-7 (Feb., 1956).

Summaries are given of the results obtained at the station Haringhata, near Calcutta, where the totality of the eclipse was 67%. Effects were observed in the E, F1 and F2 layers, but no discernible change in Es ionization could be detected. There is evidence for a corpuscular effect in the F2 region. G.M.Brown

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE.
See also under "Electromagnetic waves and oscillations".
Decimal classification 538.566.3

551.521.3

6268. ATMOSPHERIC ATTENUATION OF SOLAR MILLIMETER WAVE RADIATION. H.H.Theissing and P.J.Caplan.
J. appl. Phys., Vol. 27, No. 5, 538-44 (May, 1956).

A lumped attenuation figure for the solar millimetre wave radiation in the water vapour of the atmosphere was measured with a thermal detection apparatus. The corresponding theoretical attenuation figure was computed from the solar millimetre spectrum known from previous measurements and from the Van Vleck-Weisskopf equation and turned out smaller than the first experimental figure by a factor of about 3 in terms of decibels per kilometre. With the general structure of an absorption spectrum considered well traced by theory this disagreement can only mean a failure of the computation to yield the correct absolute absorption level in the window regions to which the experiment predominantly refers. The fault may lie either in the equation itself or in inadequately known constants required in the computation. Regardless, however, of the cause and magnitude of this discrepancy, the novel method of this paper lies in a combination of the above-mentioned experimental and computed figures to furnish a well-supported spectral attenuation function in the window region. This function, which constitutes the final result, turns out largely independent of the shortcomings in the computation part, inasmuch as theory was used to furnish merely its structure and experiment to provide its absolute level. A.

551.521.326

6269. THE HEIGHT OF THE NIGHTGLOW BY THE VAN RHIJN METHOD. F.E.Roach and A.B.Meinel.
Astrophys. J., Vol. 122, No. 3, 530-53 (Nov., 1955).

The several factors involved in the estimation of the location of the nightglow in the earth's upper atmosphere are discussed. These include the extinction and scattering in the lower atmosphere, the correction for the finite field of view of the photometer, and the allowance for contamination of the observations by integrated starlight and zodiacal light. The difficulty inherent in the inclusion of more than one upper-atmosphere emission by a single filter is discussed. Application is made to the evaluation of the heights of the emissions [O I] 5577, [O I] 6300, and Na I 5893 based on averages of photometric observations for three complete nights at Cactus Peak, California. It is found that a significant upper-atmosphere component is included by a control filter at 5300 A. Within the probable uncertainty of the extinction coefficients, upper and lower limits of the deduced heights are: 5300 (78, 43 km); 5577 (104, 62 km); 5893 (129, 108 km); 6300 (143, 116 km). The probable inclusion in the observations of a significant amount of OH means that the actual heights of the atomic emissions may be slightly greater than these mean heights for the composite emission. A.

551.521.326

6270. NIGHTGLOW HEIGHTS: A REINTERPRETATION OF OLD DATA. F.E.Roach and A.B.Meinel.
Astrophys. J., Vol. 122, No. 3, 554-8 (Nov., 1955).

Observations of the nightglow by Abadie, A.Vassy and E.Vassy in the green (5577 A) and red (6300 A + OH) are interpreted as due to the sum of radiation from (a) starlight and zodiacal light and (b) nightglow. The solution is in contrast with that obtained by Abadie, Vassy, and Vassy, who suggest two atmospheric emitting layers, a brigther one at 1000 km and a fainter one below 100 km. A.

551.521.6

6271. THERMAL RADIATION FROM THE ATMOSPHERE. R.Sloan, J.H.Shaw and D.Williams.
J. Opt. Soc. Amer., Vol. 46, No. 7, 543-7 (July, 1956).

The influence of ground level temperature and humidity on the intensity and spectral distribution of the thermal radiation reaching ground level from the clear sky has been investigated in the spectral region between 4μ and 15μ. The influence of the thickness of the emitting layer or atmospheric path viewed by the detector has also been studied by making measurements of the sky radiation from various zenith distances. Empirical relationships between the intensity of the atmospheric emission spectrum in various spectral intervals and the ground-level conditions of temperature and humidity are developed and presented in graphical form. A.

551.594.13

6272. MEASUREMENTS OF ATMOSPHERIC ELECTRIC CONDUCTIVITY IN BADGASTEIN. A.Polak.
S. B. Osterr. Akad. Wiss. IIa, Vol. 164, No. 1-4, 1-16 (1955).

German.

Measurements of the spatial distribution of conductivity of free air in Badgastein were carried out by means of a rdien aspirator. It shows in general a higher conductivity, ɔecially in the neighbourhood of a strong radioactive thermal ring, and it is conditioned by the higher emanation content the air. Near to the waterfall there is an excess of negative is caused by the Lenard effect which produces a relatively h negative polar conductivity. Diurnal changes of conducti- y of the air were established by 24 hr series of measurements by a Gerdien aspirator and registrations according to the Schering method. Both methods showed that the conductivity has a simple period with a pronounced maximum in the early morning and a weak minimum in the first hours after sunset. Relatively high conductivity occurred in the bath cabins due to free emanation from the thermal water. The measurements are comparable with those by Israel on heavy ions and condensation nuclei and by Gerke on the numbers of small ions. All measurements show that the air in the high Gastein valley has an increased ion content. R.S.Read

BIOLOGY 57/59

578

73. IMPROVED FREEZE-DRYING AND EMBEDDING 'PARATUS FOR FROZEN TISSUES. E.W.Emmart and R.Crisp.
v. sci. Instrum., Vol. 27, No. 5, 315-18 (May, 1956).

An improved freeze-drying and embedding apparatus has en constructed in which the design of the component parts ıke possible the drying of tissue under vacuum at any select- temperature between -78° and -20° C. The efficiency of eration of the equipment, with the minimum attention of the erator, is largely dependent not only upon the construction its component parts, but upon the introduction of a solenoid tomatically controlled value for the flow of water to the dif- ɜion pump; the design of drying chamber; the Teflon coupling d offset construction of the shaft of the paraffin cup; and, e introduction of gauges which afford the direct reading of mperature and vacuum. In addition, the efficient and adily accessible set of switches, dials, and stopcocks are arranged that gauges may be read and manipulations made ɔm one position. A.

578.087.77

74. A METHOD FOR THE TIME STUDY OF THE VIBRA- ONS OF THE VOCAL ORGANS. G.Podzuweit.
angew. Phys., Vol. 8, No. 6, 287-92 (1956). In German.

A description is given of a light-flash stroboscopic method observing visually and photographically the movements of e vocal organs ("Stimmlippen" and "Kehlkopf"). Photographs e reproduced at 800 frames per second. The method has agnostic and pathological applications. A.B.Wood

578.087.78

75. PHYSICAL RESPONSE REQUIREMENTS OF PRES- RE TRANSDUCERS FOR THE REPRODUCTION OF PHYSI- LOGICAL PHENOMENA. E.H.Wood.
ans Amer. Inst. Elect. Engrs I, Vol. 75, 32-40 (1956) = ɔmmun. and Electronics, No. 23 (March, 1956).

Studies are made on strain-gauge, capacitance and riable-reluctance types of transducers for measuring arte- al blood pressure, using hypodermic needles and polythene be connection. Recordings with square wave and variable equency oscillators are given, and it is shown that accurate sults can be achieved with a response characteristic flat up 6 c/s; the remaining error is primarily that due to catheter ovement. F.T.Farmer

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.843.611

76. DARK ADAPTATION AS A FUNCTION OF THE TENSITY AND DISTRIBUTION OF LIGHT ACROSS THE READAPTATION FIELD. C.A.Baker, A.Debons and F.Morris.
J. Opt. Soc. Amer., Vol. 46, No. 6, 401-4 (June, 1956).

Dark adaptation functions for three subjects were measured after preadaptation to luminances of 2500, 500, 100, 20, 4 and 0.8 ml. The distribution of light across the preadaptation field was varied so that 100%, 20%, 4%, or 0.8% of the total field area was luminous. The data suggest that different combinations of intensity and area in the preadaptation conditions, if the total amount of light is held constant, produce no important changes in the subsequent dark adaptation functions. Some applications of these data to equipment design are discussed. A.

612.843.611

6277. CHROMATIC ADAPTATION. D.L.MacAdam.
J. Opt. Soc. Amer., Vol. 46, No. 7, 500-13 (July, 1956).

The dependence of corresponding colours on different chromatic adaptations has been studied by a method of local adaptation. Both eyes were exposed simultaneously to the same colours. Observations of one second duration were alternated with adaptation periods of nine seconds duration. Different adapting colours appeared in the two halves of a simple colorimeter field, which had a vertical dividing line. The observer kept his gaze fixed upon the centre of that line. He then adjusted the colorimeter which produced the colour which replaced the adaptation colour in one half of the field, so that during the one-second observation it appeared to match the colour which replaced the other adapting colour. The colours which appeared to match under these conditions were compared with the predictions of Von Kries's trireceptor coefficient law. Various modifications of that law were tried. Systematic discrepancies from predictions of laws of this form were analysed. A hypothesis of five different receptors whose responses are merged onto three channels in the nervous system was found adequate to account for almost all of the experimental findings. The presence of a sixth different adapting process in the retina was indicated in one case. A.

612.843.721

6278. EXPERIMENTAL TEST OF LUNEBURG'S THEORY. HOROPTER AND ALLEY EXPERIMENTS. A.Zajaczkowska.
J. Opt. Soc. Amer., Vol. 46, No. 7, 514-27 (July, 1956).

Binocular visual space is, according to Luneburg, a hyperbolic space; two personal constants determine the geometry of subjective space of individual observers. Personal constants σ (the degree of depth perception) and K (the curvature of binocular space) were obtained by Luneburg's 3 and 4 point tests and served as predictors for frontal plane horopter and alley experiments. In the result, the observed distances of the straight line horopters agreed with values predicted within certain limits of confidence. The predictions concerning the shapes of concave and convex horopters and the shapes of alleys tended to hold in the case of observers of good depth perception and a relatively low absolute value of K. Three different alley experiments yielded values of personal constants agreeing with values obtained by the 3 and 4 point tests again only within certain limits of confidence. Good agreement with

prediction for all observers was obtained from an alley experiment in which physiological and technical difficulties were reduced. While a study of the constancy of σ and improvement of experimental conditions are needed, the measure of agreement obtained in the experiments reported gives considerable support for the hypothesis that binocular visual space is metric and hyperbolic. A.

612.858

6279. THE EAR AS INFORMATION-RECEIVER. (Das Ohr als Nachrichtenempfänger). R.Feldtkeller and E.Zwicker. Stuttgart: S.Hirzel (1956) 86 pp. (Monographien der Elektrischen Nachrichtentechnik, Bund 19). In German.

Constitutes Vol. 19 of a series of monographs of the "Electrischer Nachrichtentechnik". It deals mainly with researches carried out at the Institut für Nachrichtentechnik at the Technische Hochschule, Stuttgart. After an introductory discussion dealing with the general characteristics of the average ear as a sound receiver, a description is given of the Békésy audiometer as a means of registration of the threshold of audibility under varied conditions involving frequency of pure tones in the audio frequency range 20 c/s to 20 kc/s. The subject under test sits in a silent cabinet with a "press" key in his hand and headphones on his ears. He maintains pressure on the key whilst he can hear the sound in the headphones and releases it when he cannot hear it. The recorder registers the sound intensity in dB as a function of frequency and the resulting record shows the subject's auditory acuity over the whole frequency range, relative to that of an "average" person. Using this method as a basis, studies have been made of "masking" phenomena and of the audible limits of intensity variations and of frequency variations, for both tones and noises. Subsequent chapters deal with the frequency-range of the ear an the frequency-groups involved in its structure, and with the problems of loudness of pure tones and noises under various conditions of masking etc. A.B.Woo

614.89

6280. HANDLING ALPHA-ACTIVE, PYROPHORIC MATE RIALS. II. GLOVEBOX DESIGN AND CONSTRUCTION. L.R.Kelman, W.D.Wilkinson, A.B.Shuck and R.C.Goertz. Nucleonics, Vol. 14, No. 4, 65-71 (April, 1956).

For Pt I see Abstr. 5586 (1956). A detailed description is given of the construction of glove boxes on the ANL Pu Research Laboratory and Fuel Fabrication Facility; includi the provision of special openings for rotating shafts etc. The design of suitable gloves and techniques for changing gloves without spread of contamination, are considered in detail. R.D.Smit

614.89

6281. HANDLING ALPHA-ACTIVE, PYROPHORIC MATE RIALS. III. GLOVEBOX-ATMOSPHERE CONTROL. L.R.Kelman, W.D.Wilkinson, A.B.Shuck and R.C.Goertz. Nucleonics, Vol. 14, No. 5, 77-82 (May, 1956).

The main reason for choosing He as an inert gas is its ease of repurification by absorption on charcoal either at liq nitrogen temperatures or at -20° F to -40° F at high pressur Details are given of the Argonne Research Laboratory syste and the fuel fabrication facility system. The design of pump valves and filters is considered and a description given of transfer techniques using plastic pouches. R.D.Smit

TECHNIQUE. MATERIALS 62/69

66.087

6282. QUANTITATIVE ELECTRODEPOSITION OF RADIO-COBALT, ZINC AND IRON. C.J.Maletskos and J.W.Irvine, Jr. Nucleonics, Vol. 14, No. 4, 84-91 (April, 1956).

A detailed description of the procedure developed for the preparation of sources suitable for β-ray and X-ray assay with >99% recovery from solutions containing 5-10 mg. Full details are given of suitable solutions, plating conditions and the construction of the electroplating cell. R.D.Smith

771.534

6283. EXPERIMENTS ON PHOTOGRAPHIC SENSITIVITY. P.V.McD.Clark and J.W.Mitchell. J. photogr. Sci., Vol. 4, No. 1, 1-20 (Jan.-Feb., 1956).

The methods used for preparing thin sheets of silver chloride, silver bromide, binary and ternary mixed crystals of silver halides, and mixes crystals of silver bromide with silver sulphide and other metallic bromides are described in detail. The results of experiments on the chemical sensitization of these materials are presented. The conclusion has been reached that, as far as the formation and development of the latent image is concerned, there is no significant increase in the sensitivity of the mixed crystals compared with that of strained crystals of pure silver bromide. Experiments with antifogging agents, antiplumming agents, development accelerators and dye sensitizers and supersensitizers are briefly described. The causes of low-intensity reciprocity failure i the formation of the surface and internal latent images in the thin sheets are discussed in detail and methods which may b used to diminish low-intensity failure in the formation of the surface latent image are outlined.

778.3

6284. THE EFFECT OF THE FINITE THICKNESS OF TH EMULSION LAYER IN STUDYING NUCLEAR PROCESSES B THE PHOTOGRAPHIC METHOD. II. A.A.Bene. Zh. éksper. teor. Fiz., Vol. 28, No. 6, 706-10 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 532-5 (Nov., 1955).

For Pt I, see Abstr. 9338 (1955). A correction formula derived for the determination of the total number of tracks formed by a nuclear reaction within a nuclear emulsion when the number of tracks completely within the emulsion is know It is assumed that the beam of incident particles lies paralle to the plane of the emulsion, and that the tracks lie within a limited angular range with respect to the emulsion plane. J.Hughe

778.333 : 537.531 : 535.371.0

THE SPECTRAL QUANTUM- AND ENERGY-EFFICIEN OF CALCIUM TUNGSTATE X-RAY INTENSIFYING SCREEN See Abstr. 5016